Including Ham Radio Fun!

# 73 Amateur Radio Today

AUGUST 1996
ISSUE 403
USA $3.95
CANADA $4.95
International Edition

## How to save 2m and 450

See Page 4

TenTec Model 1220 2m FM Transceiver Kit

A Hot $60 Rx Kit
PVC & Slinky Vertical
PC Control Your Rig
Simple A-D Converter

*****************************5-DIGIT 48103
#000001919819#MR JUN76 270
UNIV MICROFILM 45
SERIAL PRCNG ATTNL P 1
300 N ZEEB RD
ANN ARBOR MI 48103-1553

JRC

# JST-245

## 160-10 Meters PLUS 6 Meter Transceiver

***Fifteen reasons why your next HF transceiver should be a JST-245. . .***

**1** All-Mode Operation (SSB,CW,AM,AFSK,FM) on all HF amateur bands and 6 meters. JST-145, same as JST-245 but without 6 meters and built-in antenna tuner.

**★ JST-145 COMING SOON ★**

**2** MOSFET POWER AMPLIFIER • Final PA utilizes RF MOSFETs to achieve low distortion and high durability. Rated output is 10 to 150 watts on all bands including 6 meters.

**3** AUTOMATIC ANTENNA TUNER • Auto tuner included as standard equipment. Tuner settings are automatically stored in memory for fast QSY.

**4** MULTIPLE ANTENNA SELECTION • Three antenna connections are user selectable from front panel. Antenna selection can be stored in memory.

**5** GENERAL COVERAGE RECEIVER • 100 kHz-30 MHz, plus 48-54 MHz receiver. Electronically tuned front-end filtering, quad-FET mixer and quadruple conversion system (triple conversion for FM) results in excellent dynamic range (>100dB) and 3rd order ICP of +20dBm.

**6** IF BANDWIDTH FLEXIBILITY • Standard 2.4 kHz filter can be narrowed continuously to 800 Hz with variable Bandwidth Control (BWC). Narrow SSB and CW filters for 2nd and 3rd IF optional.

**7** QRM SUPPRESSION • Other interference rejection features include Passband Shift (PBS), dual noise blanker, 3-step RF attenuation, IF notch filter, selectable AGC and all-mode squelch.

**8** NOTCH TRACKING • Once tuned, the IF notch filter will track the offending heterodyne (±10 Khz) if the VFO frequency is changed.

**9** DDS PHASE LOCK LOOP SYSTEM • A single-crystal Direct Digital Synthesis system is utilized for very low phase noise.

**10** CW FEATURES • Full break-in operation, variable CW pitch. built in electronic keyer up to 60 wpm.

**11** DUAL VFOs • Two separate VFOs for split-frequency operation. Memory registers store most recent VFO frequency, mode, bandwidth and other important parameters for each band.

**12** 200 MEMORIES • Memory capacity of 200 channels, each of which store frequency, mode, AGC and bandwidth.

**13** COMPUTER INTERFACE • Built-in RS-232C interface for advanced computer applications.

**14** ERGONOMIC LAYOUT • Front panel features easy to read color LCD display and thoughtful placement of controls for ease of operation.

**15** HEAVY-DUTY POWER SUPPLY • Built-in switching power supply with "silent" cooling system designed for continuous transmission at maximim output.

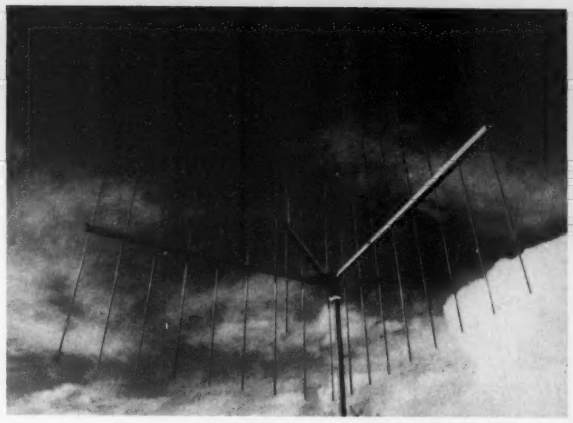
JRC *Japan Radio Co., Ltd.*

430 Park Ave., 2nd Floor New York, NY 10022 Phone: (212) 355-1180 Fax: (212) 319-5227

**CIRCLE 159 ON READER SERVICE CARD**

# Corner Beam?

## Big Forward Gain
## Wide Backward Rejection
## Exceptional Bandwidth
## Distortion Free Pattern



Your antenna makes all the difference at VHF and UHF—It determines transmitting range. It sets the limit for weak signal reception. And it decides what interference you'll hear and create.

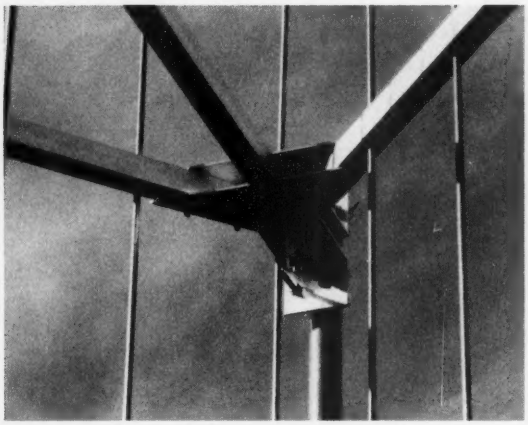
An omnidirectional antenna radiates uniformly in all direction, and it also hears noise and interference from every direction.

A directional antenna not only sends your signal where you want, it hears the signal it's pointed at, rejecting others. It also lets you operate with minimal power, cutting interference you inflict on other stations.

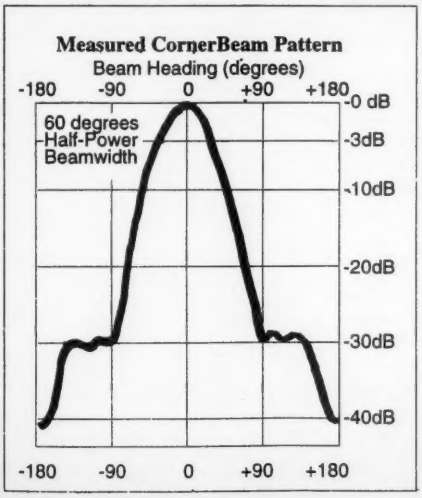
CornerBeam's clean sharp pattern without sidelobes or spikes reaches past the noise and interference to get the message through. Its wide rear rejection lets you null out strong nearby signals to reduce interference.

**Look what CornerBeam does:**

- •10 dB gain vs. dipole
- •40 dB Front-to-Back
- •60 degree Half-power Beamwidth
- •SWR <1.1:1 across the band
- •No dimension over 4 ft
- •Mounts directly to mast or tower
- •Vertical or horizontal polarization
- •No need for offset or side mount



**Measured CornerBeam Pattern**




**Corner Beats Yagi**

A yagi with the same gain would have a 10-ft boom. Yagi bandwidth would be less than half. More important, CornerBeam produces no side lobes, no back lobes.

**Improved Data Communication**

Because CornerBeam's pattern has no unwanted side spikes, phase noise is reduced to a minimum. The result is reduced data error rate, faster packet circuits. When you want a distortion free signal, think CornerBeam, not yagi.

**CornerBeam for Repeaters**

If your repeater shares a frequency with another, the deep wide null toward the rear could keep your signal out of the neighboring repeater's receiver and turn a deaf ear to its signal. A pair of CornerBeams can be combined to privide special radiation footprints. A CornerBeam aimed at an area your repeater hears poorly could improve service where incoming signals from HTs are presently too weak. CornerBeam makes it possible to increase repeater density while reducing interference.

**Bandwidth Pays Off**

With its exceptional bandwidth, your CornerBeam can be put to work right out of the box without special tweaking. It can serve you now when you're working repeaters with an FM handheld, and later when you set out to work satellites or go after small signal DX at 144.2 MHz.

CornerBeam can still be your beam when you join MARS at 143/148 MHz or team up with the sheriff's communications interface team at 158 MHz.

**Scanning Too?**

CornerBeam's gain & bandwidth extend monitoring range from aircraft to marine & public service frequencies.■

**On the Internet**
www.itsnet.com/~radventr

### Corner Beam Models

| Band | Max Dim | WindLd | Price |
|---|---|---|---|
| 2 meters | 4 ft | <2 sqft | $145 |
| 220 MHz | 4 ft | <1 sqft | $145 |
| 70 cm | 3 ft | <1 sqft | $115 |
| Dual 146/435 | 4 ft | <3 sqft | $165 |

**Construction**: Aircraft aluminum. Booms are square. Elements are solid rod. Stainless hardware included for tower and mast mounting accepts up to 1.5" dia. mast and may be rotated for vertical or horizontal polarization. Connector is SO-239 for VHF, N female for UHF. Dual-Band antenna has separate driven elements, weighs only 10 pounds.

**Dimensions** given in table are for reflector elements & booms.

**Options**: Commercial Frequency $45.

**Duplexer**: Add $80 for VHF/UHF Duplexer and cabling for single coax feed of Dualband 146/435 Corner.

**Shipping**: UPS ground to continental USA ($11 S&H). Air Parcel Post to HI, AK, & Posessions ($14 P&H). Canada ($16 P&H). Allow 2 weeks for delivery.

☐ **Yes, I want Performance in My Corner!**

__Send my CornerBeam: __2m, __220MHz, __70 cm, __Dual 146/435.

__Options: __DualBand Duplexer, __Commercial/Marine. Frequency:____

Name_____Amt. Enclosed_____

Call_____ Phone_____

Street_____ Unit_____

City_____ State_____Zip_____

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CIRCLE 57 ON READER SERVICE CARD

# You'll KICK Yourself

## If You Build a Repeater

Without Checking Out Our Catalog First!

**Hamtronics has the world's most complete line of repeater controllers, cw and voice id boards, dtmf controllers, autopatches, ctcss boards, exciter, pa, and receiver modules. Here's a sample...**

**CWID.** Traditional diode matrix, permits field changes; use with COR-3. ..... **kit only $59**

**CWID-2.** Miniature cwid board, eprom-controlled, easy to build. ..... **only $54/kit, $79 w/t.**

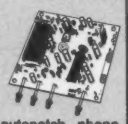
**DVR-1.** Add real speech to your repeater. Records your own voice up to 20 seconds. Use for voice id or to play club announcements. ..... **$59/kit, $99 w/t**

**COR-3.** Inexpensive, flexible COR module with timers, courtesy beep, audio mixer. ..... **kit only $49**

**COR-4.** Complete COR and CWID all on one board. Low power CMOS logic, timers, courtesy beep, 2nd rcvr input, id in eprom. ..... **only $99/kit, $149 w/t**

**COR-5.** Microprocessor controller with all the bells & whistles! Full autopatch, reverse ap, phone remote control, lots of dtmf control functions, all on one board, as used in REP-200 Repeater. ..... **$379 w/t**

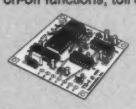
**COR-6.** COR timers, courtesy beep, voice id. Like COR & DVR-1 on one board! Record your own voice up to 20 seconds. Low power CMOS, non-volatile memory.



..... **kit only $99, w/t only $149.**

**AP-3.** Repeater autopatch, reverse autopatch, phone line remote control. Use with TD-2. ..... **kit $89**

**TD-2.** Four-digtit DTMF decoder/controller. Five latching on-off functions, toll call restrictor. ..... **kit $79**



**TD-4.** DTMF controller as above except one on-off function and no toll call restrictor. Can also use for selective calling; mute speaker until someone pages you. ..... **kit $49.**

**TD-3.** CTCSS Decoder/Encoder. Prevents repeater access unless tone is present. Can also be used with mobile to access repeaters. ..... **kit only $29.**

# HIGH QUALITY VHF & UHF FM TRANSMITTER AND RECEIVER MODULES

**FM EXCITERS:** 2W output, continuous duty.

**TA51:** 6M, 2M, 220MHz. .....**kit $99, w/t $169.**

**TA451:** 420-475 MHz. .....**kit $99, w/t $169.**

**TA901:** 902-928 MHz, (0.5W out)..... **w/t $169.**

**VHF & UHF AMPLIFIERS.**

Output levels from 10W to 100W **Starting at $99.**

**FM RECEIVERS:**

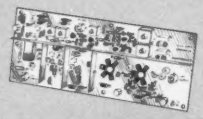
- **R100 VHF FM RECEIVERS** Very sensitive – 0.15uV, superb selectivity – both crystal and ceramic IF filters for >100 dB at ±12kHz (best available anywhere), flutter-proof squelch. For 46-54, 72-76, 140-175, or 216-225 MHz. ..... **kit $129, w/t $189.**
- **R144/R220 RCVRS.** Like R100, with 2M or 220 MHz helical resonator in front end. .....**kit $159, w/t $219.**
- **R451 FM RCVR,** for 420-475 MHz. Similar to above. .....**kit $129, w/t $189.**
- **R901 FM RCVR,** 902-928MHz. .....**$159, w/t $219.**

# TRANSMITTING AND RECEIVING CONVERTERS

**Go on a ham satellite adventure! Add another band for the next contest. Thrill in the excitement of building your own gear, and save a bundle.**

**No need to spend thousands on new transceivers for each band!**

- Convert vhf and uhf signals to/from 10M.
- Even if you don't have a 10M rig, you can pick up very good used xmtrs & rcvrs for next to nothing.
- Receiving converters (shown above) available for various segments of 6M, 2M, 220, and 432 MHz.
- Kits from $49, wired/tested units only $99.



- Xmitting converters (at left) for 2M, 432 MHz.
- Kits only $89 vhf or $99 uhf.
- Power amplifiers up to 50W output.

## LOW NOISE RECEIVER PREAMPS

**LNG-( ) $G_A A_S$ FET PREAMPS**

**STILL ONLY $59!**

- Make your friends sick with envy! Work stations they don't even know are there.
- Install one at the antenna and overcome coax losses.
- *Available for 28-30, 46-56, 137-152, 152-172, 210-230, 400-470, and 800-960 MHz bands.*

**LNW-( ) ECONOMY PREAMPS**

**ONLY $29 kit, $44 wired/tested**

- Miniature MOS FET Preamp
- Solder terminals allow easy connection inside radios.
- *Available for 25-35, 35-55, 55-90, 90-120, 120-150, 150-200, 200-270, and 400-500 MHz bands.*

# WEATHER FAX RECEIVER

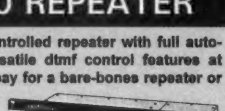
**Join the fun. Get striking images directly from the weather satellites!** A very sensitive wideband fm receiver **optimized for reception of NOAA APT and Russian Russian Meteor weather fax** images on the 137 MHz band. Covers all five satellite channels. Scanner circuit and recorder control allow you to automatically search for and tape signals as satellites pass overhead, even while away from home.

- **R139 Receiver Kit less case** ..... **$159**
- **R139 Receiver Kit with case and 12Vdc pwr adapter** ..... **$189**
- **R139 Receiver Wired in case with 12Vdc adapter** ..... **$239**
- **Internal PC Demodulator Board and Imaging Software** ..... **$289**
- **Turnstile Antenna** ..... **$119**
- **Weather Satellite Handbook** ..... **$20**

Get more features for your dollar with our

# REP-200 REPEATER

**A microprocessor-controlled repeater with full autopatch and many versatile dtmf control features at less than you might pay for a bare-bones repeater or controller alone!**



***Kit still only $1095***
***w&t still only $1295***

50-54, 143-174, 213-233, 420-475 MHz (902-928 MHz slightly higher.)

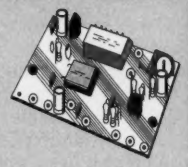
**Digital Voice Recorder Option** ..... **only $100.** Great for voice ID or making club announcements.

**REP-200C Economy Repeater.** Voice ID, no dtmf or autopatch. ..... **Kit only $795, w&t $1195.**

**REP-200N Repeater.** No controller so you can use your own. ..... **Kit only $695, w&t $995.**

# SUBAUDIBLE TONE ENCODER/DECODER

**Access all your favorite closed repeaters with TD-5 CTCSS Encoder/Decoder**



**Encodes** all standard subaudible tones with crystal accuracy and convenient DIP switch selection. Comprehensive manual also shows how you can set up a front panel switch to select between tones for several repeaters. Receiver **decoder** can be used to mute receive audio and is optimized for installation in repeaters to provide closed access. High pass filter gets rid of annoying buzz in receiver.

- **TD-5** CTCSS Encoder/Decoder Kit ..... only **$39**
- **TD-5** CTCSS Encoder/Decoder Wired/tested ..... **$59**

# Finally – A Professional-Quality Receiver to Monitor Weather Broadcasts!

**Our new RWX is a very sensitive and selective Hamtronics® grade receiver to monitor critical weather and emergency broadcasts from NOAA/NWS or Environment Canada.**

**Excellent 0.15µV sensitivity** provides good reception even at distances of 70 miles or more with suitable antenna. No comparison with ordinary consumer radios or scanners! **Automatic mode** provides storm watch, alerting you by unmuting receiver and providing an output to trip remote equipment when an alert tone is broadcast.

**Essential** for airports, police and fire departments, CAP, broadcast stations, state and local emergency managers, amateur repeaters – anyone needing a professional quality receiver. Because of its reasonable price, it is also handy for bikers, hikers, boaters, hunters, farmers – any one who needs up-to-date weather info and emergency warnings, even from distant stations.

Small enough for emergency or portable use, it can be powered from a small 9-12V battery when needed. Crystal controlled for accuracy; **all 7 channels provided** (162.40 to 162.55).

You can buy just the receiver pcb module in kit form or buy the kit with an attractive metal cabinet, AC power supply, and built-in speaker. It is also available factory wired and tested.

- **RWX Rcvr kit, PCB only** ..... **$79**
- **RWX Rcvr kit with cabt, spkr, & 12Vdc adapter** ..... **$99**
- **RWX Rcvr wired/tested in cabt with spkr & adptr** ..... **$139**

# WWV RECEIVER

Get time & frequency checks without buying multi-band hf rcvr. Hear Geo Alerts for conditions affecting radio propagation. Very sensitive and selective crystal controlled superhet, dedicated to listening to WWV on 10.000 MHz. Performance rivals the most expensive receivers.

- **RWWV Rcvr kit, PCB only** ..... **$59**
- **RWWV Rcvr kit with cabt, spkr, & 12Vdc adapter** ... **$89**
- **RWWV Rcvr wired/tested in cabt with spkr & adapter** ..... **$129**

- Buy at low, factory-direct net prices and save!
- For complete info, call or write for free catalog. *(See last month's ad for more products.)*
- Order by mail, fax, or phone (9-12 AM, 1-5 PM eastern time).
- Min. $5 S&H charge for first pound plus add'l weight & insurance.
- Use VISA, Mastercard, Discover, check, or UPS C.O.D.

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**On the cover:** Ten-Tec provided the cover shot this month of their Model 1220 2 meter FM tranceiver kit. Included in the photo is their 1222 power amplifier kit which is available as an accessory.

**Feedback:** Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.


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**Contract:** Even the most cursory glance at this text is sufficient to bind you, morally and legally, to take a kid (or kids) along on Field Day, get 'em fired up on amateur radio, and then help 'em get started toward a license. You'll feel good about yourself and our legal deoartment won't have to hassle you.

# NEVER SAY DIE

Wayne Green W2NSD/1

As a salve for those readers who are monomaniacal about the hobby and don't want to read or know about anything else, my editorial this month is strictly ham oriented. This is frustrating because there have been some amazing non-ham or semi-ham things taking place that I think many of you would enjoy reading about. Like a fantastic $5 book I've found that explains an ultra-simple way anyone can find out what they're allergic to, and thus help them get rid of arthritis, multiple sclerosis, and a bunch of other weak immune system miseries (like cancer).

Then there was my four-hour guest shot on the Art Bell W6OBB talk radio show. The thousands of letters and orders for my booklets resulting has dominated my life for the last month. My talking about amateur radio has resulted in hundreds of new subscribers. It's had my copy and folding machines running overtime, with me data entering the booklet and subscription orders, then assembling and mailing my booklets. Whew!

In order to keep this month's column hammy I've robbed some of the stuff from my 84 pages of editorials not yet published in *73* booklet, making it now editorials mostly not yet published in *73*.

**News Flash: Money Talks**

Many nervous Techs have been asking me what I think of the move by commercial interests to buy our 144 and 450 MHz bands. My answer is simple: Money talks when you're dealing with politicians. Even the FCC (as well as Congress) was amazed at how much the spectrum turned out to be worth when they put it up for auction. Mmm, billions! More money to spend! More pork! Let's see now, what social programs can we cook up to take care of this bonanza? If you're not up on how Congress works, there are a couple excellent books on my $5 recommended reading list that will enlighten and disgust you. Hey, they might even be enough to get you to start thinking. Well, maybe not. We seem to have a lot of hard corpse cases out there in hamland.

However, there's one other commodity politicians understand, and remember that the FCC Commissioners are all political appointees. Politicians understand votes.

That's why, when I got fed up with the idiotic repeater restrictions Prose Walker engineered, I organized a hearing before the Commissioners to get our repeater rules changed. I not only brought in a parade of carefully rehearsed repeater group representatives to testify, I also waved a thick stack of petitions at the Commissioners. The repeater groups had collected thousands of signatures at hamfests and club meetings, and it was these, more than reason, that carried the day. Reason is not a powerful weapon when dealing with politicians. Anyway, the result was that we brought about the largest bunch of rule changes in the history of the FCC. We even helped trigger not just the deregulation of amateur radio, but also the other services.

Anticipating just such an attack as we are now facing from the moneyed big boys, I've recently proposed in my editorials that every ham club make it project number one to get a club member elected to their state legislature. We need the clout ham legislators can provide in every state, and not just to help us fight off commercial raids on our bands, but also to kill tower restrictions and to help implement my own pet project: an eight-year course in electronics, communications and computers in every school in the country, grades 5-12. Ham legislators also will have the ear and eye of the media, which will also help give us some desperately needed political clout.

Two meters is the most used of all out ham bands, by a wide margin. What will the loss of two meters (and 450) mean to us? Well, that would pretty much put over half our hams out of business. The Tech half, which has been brainwashed into believing that learning the code is totally beyond their ability, will have few practical options. Thus, in eight to ten years, when their licenses aren't renewed, the FCC figures will drop precipitously.

Oh, a few will manage to overcome their mental block about the code and join us on the low bands. Fewer still will move to 50 or 222 MHz.

With all those satellites up there providing dependable communications, there's no longer much commercial interest in our HF bands, so we'll probably hold them until the few of us that are left die off. Frankly, I expected to see our virtually unused microwave bands be the first to go. These are prime targets for the proposed new satellite consumer services.

Meanwhile, I'll be checking the ham club newsletters for signs of activity in backing club members in a run for state legislatures, at least with as much enthusiasm as supporting Walk-A-Thons. We sure don't have any money, so all we've got are votes to work with. And that means playing the politics game. Or else.

**Atlanta Hamfest!**

Well, it seemed more like a computerfest, looking at the exhibits. And more like a geriatric convention, looking at the attendees, what few there were of them. This is terrible!

Atlanta is the hub of the whole southeastern US, yet I doubt if a thousand hams bothered to turn out for the hamfest. I went around the place counting heads several times during the day. I came up with between 600 and 700 on most sweeps, and that included the out-of-the-way commercial exhibit area, the three talk rooms and the flea market. I saw almost no youngsters all day.

I checked the talks every hour to see what kind of crowds they were pulling. Packet: zero! Repeaters: one. DXCC pulled a big four. The ARRL meeting pulled a whopping nine. Antennas had five. Beginners had four. The two DXpedition talks pulled 17, the biggest crowd of the hamfest — except for my talk, which was scheduled at the close of the show, when everyone was hot and tired, and pulled 48. There was no mike, so I had to do the best I could over the noise of the big fans (air conditioning in sizzling Atlanta? Har-de-har). The hamfest was held in a dirty old Sears warehouse.

Now here's a show that should have pulled in hams from all over the south. They should have had at least 15-20,000 hams there. They should have had the whole ham industry exhibiting. They should have had top-notch entertaining speakers to help pull in the crowds. So what has happened? Is ham radio dying in the South, or is this the sad result of local clubs refusing to cooperate for the good of the hobby?

We're at a time when we need all of the cooperation we can get between clubs. With the threatened loss of our no-code bands, and with well over half our hams being Novices or Techs, the last thing we need is foot-shooting rivalries.

The club couldn't afford to bring me down to talk, so I paid my own (and Sherry's) way, hotel, rental car, and meals. What I found was a well-lit flea market area packed with software sellers (mostly games), and the commercial exhibitors way off in a dimly-lit back area, where

*Continued on page 31*

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# LETTERS

## From the Ham Shack

**David Plett 3A2LZ.** Greetings from a US ham in Monaco. I am strongly opposed to the idea of upgrading senior citizens, as an article proposed. Here's why. The basic purpose of amateur radio is to develop a pool of people trained and skilled in electronics and communications. Reducing the technical knowledge and requirements is contrary to this goal. Math requirements certainly should not be reduced. In fact, they probably should be increased. You are not required to do everything longhand to the 19th decimal place. "Filling in the blanks" and basic calculator functions suffice. The correct answers are easy enough to memorize. I memorized the Advanced and Extra theory questions in three days while driving around central Florida during a short stay in the US in 1993. The math included is part and parcel of basic technical requirements for any higher-class amateur radio license in any country I know. I am against favoritism. This is not in a spirit of cruelty, or to say that experience does not count or that we should not try to help those who have difficulty with the theory. However, the fact that somebody is a good "on-air" ham or a nice guy should not be an excuse for allowing technically unqualified people to be given higher licenses. The better response is to help those with difficulties. Those of us who have an easier time with theory, code, or regulations (my most difficult area) have an obligation to help others. It has been suggested that the US technical requirements are higher than those generally used in Europe. This is not so. Most US hams I speak to find the Advanced test to be the most difficult technically. The Extra exam covers mostly VE matters. From my exposure to European hams, the technical exam for the entry-level license (VHF only), where there is no Novice license, covers approximately the same material as the Novice through Advanced US tests. However, it is not always "multiple-guess" and often requires one to illustrate and analyze circuits without having seen them previously in the same form. The CW test usually requires both sending and receiving. The receiving test is even more difficult since it is usually not multiple-choice. The transmit test sometimes requires up to five minutes of text be sent error-free. We need to keep high technical standards for amateur radio licenses; not to keep people out, but to fulfill the obligation to train people for the real world of electronics today.

### The Smithsonian Answers

**Bernard S. Finn, Curator, Electrical Collections, Smithsonian.** In recent articles in the magazine *73 Amateur Radio Today,* John Wagner has made several statements about the historical role of Nikola Tesla, about the Smithsonian's treatment of Tesla, and about Mr. Wagner's communications with the Smithsonian. Not surprisingly, my views are somewhat different from his, as reflected in the following comments.

#### I. The historical role of Tesla

There is little question that Tesla was a genius, whose fertile mind generated a number of ideas at the cutting edge of the electrical technology of his day. Indeed, plausible arguments are made that some of his concepts can be useful in investigating phenomena that we still don't understand. However, like many geniuses, Tesla was a loner. He had difficulty working with other engineers—whether in explaining his ideas to them or in considering their criticisms. The unfortunate consequence of this was that his impact on practical technical developments was severely impaired. This does not make him less interesting; indeed, for those of us who are concerned with the roots of creativity, it makes him, if anything, more so. But it does mean that we should be careful in what we claim were the consequences of his activities.

Tesla's concept of the rotating field was clearly innovative and was recognized as such by George Westinghouse when he negotiated to purchase the patents in 1888/9. But to claim, in Mr. Wagner's words, that "he created the polyphase alternating current system of motors and generators that powers our world" ignores contemporary European systems that relied on the work of Pacinotti, Brown, Dobrowolsky, Wenstrom, and also Westinghouse engineers who, with Tesla's help, translated those patents into practical electrical technology.

It also ignores the complexity of the history of electric power systems. A starting point might arguably be the development of the self-excited dynamo in the 1860s (Siemens, Wheatstone) which was efficient enough to make lighting and power systems (both AC and DC) practical, especially with better magnetic design in the 1870s (Gramme and others). That made it feasible for arc lighting, incandescent lighting, street railways, and other applications to become widely available, The AC transformer in the mid-1880s (Gaulard, Gibbs, Blathy, Zipernowski) made possible long-distance transmission (though this could also be done, with less efficiency, for both AC and DC using motor-generator sets). Multiphase AC operation, with which Tesla is associated, made transmission more efficient; it also gave us an AC motor. More recently, development of means for transforming DC has meant even more efficient means of long-distance transmission at very high voltages.

Incidentally, Edison's role in this particular sequence is modest, being confined primarily to the design of a more efficient DC generator.

Tesla is given credit by Mr. Wagner for "every essential of radio." This statement is presumably based on his patents for basic tuning concepts. Eventually the US Supreme Court held that these, together with patents of John Stone and Oliver Lodge, anticipated those of Marconi. But Tesla was ineffective in promoting any system of his own, and although it is intriguing to think that his work may have had a significant impact on others, good historical evidence of that is lacking. Starting from the experiments of Hertz, it was Marconi, Stone, De Forest, Fessenden, and Braun, among others, who developed practical radio technology. They were aware of some of the details of what Tesla was doing, but, as far as we are able to discern, they came to their own basic ideas independent of him. We can therefore marvel at Tesla's early understanding and articulation of some important concepts, but should beware of extending him credit for everything that followed.

#### II. The Smithsonian's treatment of Tesla

Although the Smithsonian is a large enterprise, so also is the scope of our mandate. Our museums cover a vast range of history, culture, and technology. Our resources—in space, money, collections, and personnel—are limited. Because we cannot address everything in our exhibits, we generally take one of two approaches. We may do a broad survey—as presently is the case with the "Information Age"—where individual subjects and people are given relatively brief mention. Thus, in that exhibit, in a section on wireless and radio, Tesla shares space with Hertz, Lodge, Marconi, De Forest, Armstrong, and others. The other approach is to do a smaller exhibit with a focus on a particular topic or person. Thus, in "Lighting a Revolution," we pay special attention to the incandescent lamp and to Edison. Other people are included, most notably those who were directly involved in that development—like Brush, Farmer, Thomson and Swan. We pay less attention to subjects like the competing gas light technology or the development of later distribution systems.

In "Lighting a Revolution," we try to describe the origins of Edison's work and as well as its impact. Our concern is with the light bulb. We do not claim, as Mr. Wagner suggests, that Edison "invented DC electricity" or that he "invented AC electricity and harnessed Niagara Falls." We argue that, because of the popularity of the incandescent lighting, there was an incentive to develop large-scale generating systems (at the same time granting that there were other factors, including street railways and electrochemical processes). We allow this argument to lead us to say that the light bulb was a key element encouraging the creation of the Niagara Falls station, not that "he made the Niagara project possible." There is no claim that Edison had anything directly to do with that station. Indeed, because we use Niagara Falls simply as

an indication of America's commitment to a new electrical age, we, rightly or wrongly, don't describe it in any detail.

We do, however, include a Tesla motor and a nameplate from a Niagara Falls dynamo (we have the dynamo itself in our collection, but at 85 tons it would not easily fit in the exhibit). There is a picture of Tesla and a short biographical sketch (which admittedly are not prominently displayed).

Mr. Wagner notes that this exhibit was sponsored in part by the Thomas Alva Edison Foundation (actually through an International Committee for the Centennial of the Electric Light). We are very sensitive to the problems potentially associated with sponsorship, no matter where it comes from. Unfortunately, exhibits cost money, and it is necessary in most cases for us to seek outside help—which usually comes from people who are interested in the subject we want to treat. Realizing this, we insist that the money comes without strings, that we are the ones who determine what objects and what text are included. In this particular case I know that the committee exercised no influence over the content of the exhibit.

In the catalog of the exhibit, mentioned by Mr. Wagner, we included the biographical sketch of Tesla described above. A revised edition specifically credits his patents as the basis for the Niagara generators.

Several years ago we organized a one-case exhibit for a special event at the National Academy of Sciences. Afterwards we displayed it for several months near the Niagara Falls nameplate mentioned above. It was well lit and was definitely not "in a darkened hallway next to the men's room," as stated in Mr. Wagner's article.

We have long been of Mr. Wagner's view that a more extended study of Tesla would be appropriate for an exhibit. Unfortunately, we have virtually no artifacts for such an effort beyond those already in "Lighting a Revolution." We obtained a small grant to explore the possibilities of a joint endeavor with the Tesla Museum in Belgrade, where virtually all the surviving Tesla material is preserved. They were excited about the possibilities and some tentative agreements were made. We hoped to have something together by 1993, the centennial of the Tesla displays at the Columbian Exhibition in Chicago. Tragic political events with which all of us are familiar intervened, and the project was put on hold. Recent developments hold promise that we may be able to begin again, assuming that further funding can be found.

I should add, however, that when we do such an exhibit it will not be a simple celebratory event of the sort Mr. Wagner seems to envision, any more than "Lighting a Revolution" or the "Information Age" are. This is a history museum; in it we try to promote a better understanding of people and events by presenting them in the context of their times. The complexity and richness of personalities like Tesla and Edison deserve no less.

Meanwhile, when we make some modifications in the "Lighting" exhibit next year to include more recent developments in lamp technology, we plan to expand our treatment of AC systems, which will allow us to say more about Tesla's contributions.

**III. John Wagner and the Smithsonian**

For several years Mr. Wagner has been attempting to have Tesla better represented in this museum. He is not alone in this desire (nor is Tesla the only person with advocates) and we appreciate his efforts. In the process, he has no doubt encouraged a number of people to learn about this remarkable man, and he has encouraged us in our own researches.

I have been especially impressed by the fact that he has gotten his third-grade students to learn about Tesla. They have been articulate in their letters to the Smithsonian and they have apparently been sufficiently persuasive to corporation presidents to elicit $50 and $100 contributions to pay for the casting of a bust of Tesla which had been sculpted by the father of one of the students. Certainly this is a good thing for them to do—as long as they realize that we may have good reasons for not automatically acceding to their demands that this bust then be exhibited at the Smithsonian.

As Mr. Wagner notes, the bust was offered to one or two other museums and then to us. The Smithsonian has a policy of not accepting busts unless they are made from life and we declined the offer. Furthermore, there was no particular reason to accept it, since we have no gallery of inventors or other context for it.

We do have a bust of Edison, as Mr. Wagner mentions. It was made from life, by a phrenologist who wanted to examine the bumps and hollows on Edison's head—making it doubly interesting. It is exhibited (not near Tesla's motor) as part of an attempt to demonstrate how Edison had excited public admiration even before he started work on the electric light; this was an important factor when he looked for funding for his investigations.

In sum, there is no vendetta or conspiracy within the Smithsonian against Nikola Tesla. We currently have an exhibit featuring Edison's electric light—because we have excellent material and an interesting story to tell. Circumstances in the future may lead us to treat other Americans of that pioneering generation, like Charles Proteus Steinmetz, or Elihu Thomson, or William Stanley. We had specific plans to do so for Nikola Tesla. At the moment these have been thwarted, but we hope we will be able to resume the endeavor before long.

**John Uscinowski KE2O (ex-W2JMR).** I have been licensed since 1935. I built my own test equipment, transmitter, and receiver. I remember going to Cortlandt Street to Harrison Radio, Leeds, and Blan The Radio Man to buy parts. Since I lived in Yonkers, it was a nickel on the trolley and a nickel on the Van Cortlandt subway. Please keep plugging away, steering us back toward basics.

*It was also a nickel via the BMT subway from Brooklyn, so I spent a lot of time shopping the radio stores of Cortlandt Street back in the 1930s. And Radio, Wire, Television, later named Lafayette Radio, 100 Sixth Avenue, was a wonderful source of parts. Then there was the WWI surplus stuff on Fulton Street ... Wayne.*

**Alexander Dumble.** Your recent guest appearance on the Art Bell Show was the best show of the entire series to date. Your stands on technology and the philosophical applications give a posture of hope and accomplishment; and I am one who dearly appreciates what you've brought to the arena. The cold fusion phenomena has captured my attention, and I want to build a working model. In my circle of friends we have built and operated wind-powered electrical generators, and these devices are encouraging. However, the thermal potential of cold fusion cells really sounds wonderful. So getting information to start experiments is now paramount.

Your presentation concerning Bob Beck was delightful to hear. Bob has been a mentor to me and many others for the past decade, going back to the old Psychotronics Club, here in the LA area. The club is no longer going, but the legacy that Bob has imparted is very much alive and well. Personally, I have assembled many Beck devices, and so far have built thirty of the "plant stimulators." I was an original subscriber to *Byte*. Despite all the floods and earthquakes, these original issues of *Byte* are still here with me and treasured. Thank you, sir, for what you have brought to the world.

*Wow! And just when I thought I was beating Rodney Dangerfield in the "don't get no respect" race. Well, maybe this counters a nasty note I got from some sniveling lily-livered yellow-bellied Philadelphia coward who didn't have the guts to sign his name ... Wayne.*

**John Schultz W4FA.** Shame on you for printing that article on antennas using copper foil tape without checking things out. The 3M tapes mentioned are extremely difficult to find and the *only* distributor for them in NC has a $75 minimum order.

*Anyone else have trouble finding the foil tape? If so, make an omelet by buying $75 worth and running an ad to sell the stuff to hams retail. Look on any problem as a golden (well, copper) opportunity ... Wayne.* 73

# QRX . . .

## FCC Criticizes Consumer Equipment

The FCC recently released a statement saying that most Radio Frequency Interference (RFI) problems are caused by faulty design of consumer electronics equipment such as VCRs, telephones, and TVs. The statement is good news for hams who now have the FCC on record as agreeing with what many hams have maintained for years. Such statements will be of great value in fighting RFI complaints and defending hams against capricious lawsuits which some angry consumer gear owners have initiated.

Meanwhile, the FCC has given up on its pilot project, which tasked consumer electronics service shops with evaluating RFI complaints. The Tampa FCC began the project in 1994 but only one shop was ever certified and its spokesman concluded that most problems were caused by unlicensed transmitters using illegal power. Also, it was never settled as to who would pay for the shop's services. Most consumers were unwilling to pay to have their RFI evaluated. Reportedly, the FCC is no longer handling any RFI complaints and is advising consumers who complain to direct their comments to the Electronics Industries Association, a group that represents equipment manufacturers.

TNX Billy Williams N4UF, *Balanced Modulator*, North Florida Amateur Radio Society's newsletter.

## Pretty Sneaky

The April OH-KY-IN ARS foxhunt was one of deception—the fox, Dick WB4SUV, had taped a quarter-wave dipole to the bottom side of a fishing pole. The coax ran through the center of a bamboo prop for the pole. The batteries and transmitter running 50 watts were located inside an adjacent tackle box with a see-through cover, filled with fishing lures. The equipment was set up under the new Central Bridge on the Kentucky side of the river, and included two volunteer fishermen. The high power on the water's edge created many reflections on both sides of the river, along with a reported 100 dB attenuation needed two miles away in Devou Park. The sniffing part of the hunt was interesting, as both teams avoided disturbing the fishermen!

TNX Dick WB4SUV, *The Q-Fiver*, official newsletter of the OH-KY-IN Amateur Radio Society.

## Amateur Radio Called an "Invaluable" Resource

A powerful late winter storm triggered severe thunderstorms, tornadoes and up to golf-ball-size hail over central and south Alabama. The National Weather Service said it issued 48 tornado and severe thunderstorm warnings during the afternoon and evening of March 18, 1996. "So many warnings that we overwhelmed the media in some situations," said Brian Peters WD4EPR, a Weather Service meteorologist in Alabaster.

At the Weather Service Forecast Office in Alabaster, Skywarn teams went on duty in mid-afternoon, opening nets on 2 meters, 440 MHz and 220 MHz, and remained there for nearly six hours. Amateurs manning the Net Control posts described the outbreak as one of the most intense in recent history, with severe weather occurring in several parts of their coverage area simultaneously. As powerful thunderstorms approached central Alabama from the west during the afternoon, radio amateurs began reporting damaging winds, hail, heavy lightning, and torrential rains on W4CUE, the Birmingham Amateur Radio Club's 146.880 MHz repeater. Amateurs operating a separate Skywarn Net in Hueytown in west Jefferson County assisted by turning in reports they were receiving. Weather Service forecasters listened closely to storm spotters and compared their information to the data being fed by Doppler radar.

While severe thunderstorms were pounding Jefferson and Shelby Counties, heavy thunderstorms began developing almost explosively in a line stretching from Birmingham south to near Montgomery; at one point, at least six counties were under warnings at the same time.

Radio amateurs activated Skywarn Nets in Montgomery, after getting advance warning from hams at the Alabaster Forecast Office who were using a recently installed 220 MHz link, connected to the N4PHP 220 MHz repeater in Shelby County. Numerous severe thunderstorm and tornado warnings were read over the link, sometimes giving Montgomery Skywarn teams their first notice that a warning was being issued for their area.

Peters said radio amateurs did a fabulous job. "I was amazed at the reports coming from hams all over the state and how well the hams were working together. It used to be that hams gave us reports from just the local area, but they were giving us information from Tuscaloosa, Fayette, Monroe County, and Montgomery.

"Amateur radio proved its worth again as an invaluable source for confirmation of weather events." Peters praised the speed with which amateurs relayed severe weather reports to the Weather Service. "We were getting reports from a bunch of different places and, nine times out of ten, the first reports were coming from hams."

Amateurs in the Montgomery area provided real-time observations of a funnel cloud north of the city and later reported a tornado on the ground. The tornado first touched down in Elmore County and then moved into Tallapoosa County, remaining on the ground for 30 miles, Peters said. In Tallapoosa County, the tornado hit a marina on Lake Martin and caused heavy damage to mobile home parks.

The ARRL's Alabama Section Manager, Tom Moore KL7Q, of Salem, was actively involved in storm spotting in east Alabama. "We were closely following the Montgomery activity that tracked across Elmore and Tallapoosa Counties. We had a live sighting of the tornado for several minutes before it hit the marina and Jackson's Gap, and several other severe thunderstorms down as far as Lee and Chambers County," Moore said.

Injuries were reported in Lowndes County, southwest of Montgomery, and more than 60 families were left homeless by the storms.

Peters said being within earshot of amateur radio proved handy to meteorologists analyzing Doppler radar displays of the storms. "I noticed that the staff every once in a while would hear words like 'golf ball.' Everybody at the radar console would get quiet and listen to what was coming in over the amateur radios."

A Skywarn team member who monitored emergency frequencies during the outbreak praised the efforts of his fellow hams. "This was the best Skywarn operation I've heard yet, on the part of the volunteers running the nets and on the part of the general ham community in providing timely, useful information," said Jim Smiley KE4CAP, of Alabaster.

Amateurs serving as Net Controls in Alabaster included Rick Kimbrell KC4RNF (ARRL Alabama Section's Emergency Coordinator), John Simons KC4UCP, Mark Parmley WA4UHC, and David Black KB4KCH.

Skywarn Nets were also active throughout east and west Alabama, including Tuscaloosa, Calhoun, St. Clair, Blount, Chilton, Tallapoosa, and Talladega Counties. In east Alabama, the Salem Hill Skywarn Net had an estimated 44 check-ins. Amateurs also staffed the Birmingham-Jefferson County EMA headquarters, assisting with damage reports.

Amateurs running Net Control Posts praised the quality of reports received from spotters in the field. On Birmingham's 146.880 MHz repeater, numerous hail reports were received from hams who gave specific size and location information along with wind speed estimates and other pertinent data.

Rick Kimbrell called the episode a test of nerves, hearing, coordination, organizing skills, and writing speed. "I thought the nets ran very well," Kimbrell said. "I was really pleased to see and experience working with the Montgomery group and the link that has been established. I thought it worked great."

The March 18th emergency marked at least the third time radio amateurs have set up Skywarn Nets for the Weather Service in 1996. Ironically, the March 18th storms forced a change in plans for Peters, who had been scheduled to lead a Skywarn training class for amateurs in Montgomery that evening. When the storms broke out, Peters canceled his appearance and remained at the Alabaster Forecast Office instead, manning one of the Doppler display consoles and analyzing wind patterns. Kimbrell, who had planned to accompany Peters to the Montgomery meeting, assisted with Skywarn Net Control duties instead, remaining on the air for nearly five hours.

From an article by David Black KB4KCH, ARRL Alabama Section Public Information Officer, in the April 1996 issue of *The BirmingHAM*, Official Publication of the Birmingham Amateur Radio Club.

## It's a Fashion Statement

The "typical" ham:

- Wears button-up shirts, usually done up to the collar button but *never* undone below the second button.
- Wears an undershirt, even on hot, humid days.
- Wears polyester pants (usually too short).
- Wears pants revealing argyle socks and well-worn, outdated shoes.

• Has at least two writing implements in breast pocket of shirt.

• Has a digital watch, normally with two time zones (one of which is set to GMT), synchronized to the second with WWV or CHU.

• Is at either extreme of the body-weight spectrum.

• Wears glasses—even those who should only wear glasses for reading will actually wear them all the time.

• Has a wallet hopelessly overstuffed with pieces of paper of little or no importance.

• Has hair that's short and/or gray and/or thinning, devoid of style and probably not as clean as it should be.

• Has a handie with the "extra capacity" NiCd battery pack and the "Mega-gainer" antenna which serves to poke you in the face (or other, equally sensitive, body areas) when it is swung around.

• Uses Q-codes even in casual conversation.

• Wears a plastic name badge with the callsign bigger than the name.

## Your Car's a Statement Too

The "typical" ham's car:

• Is typically, but not always, purchased used, with careful attention paid to large, flat horizontal areas of metal.

• Must have automatic transmission so that something as trivial as operating the vehicle does not interfere with a "QSO."

• Has lots of leg room so the driver can operate iambic paddles strapped to his calves.

• Has the ashtray removed to allow more room for radio equipment.

• Has loose wires visible either under the dashboard or in unusual place(s).

• Back seat contains the following: old copies of ham magazines; current copies of ham magazines; spare wire mag-mount; butane-powered soldering iron; solder; empty cigarette packs; parts of various antennas; SWR bridge; literature about new radios; more copies of old ham magazines.

• Will sport at least one of these bumper stickers:

ICOM–discover the quality
KENWOOD Amateur Radio
Yaesu Communications Equipment
Amateur Radio Spoken Here
Dayton HamVention 19__
Amateurs Do It 'Til Their Giga-hertz!
Hams Do It With Greater Frequency!
This Car Climbed Mount Washington

• Mechanics can easily identify a "ham" car by looking under the hood. Large wires lead mysteriously from the battery, which is usually about 875CCA, into the cockpit of the car. Careful attention has been paid to installing resistor-spark plugs and RFI suppression wires and ignition components. Special ingenious modifications have been made to the battery box to allow the installation of this *huge* battery—often involving bungee cords and bent pieces of sheet metal. The alternator is either new or has been recently replaced with a 100A unit.

• Bristles with antennas of differing lengths—some of these antennas look like big marshmallows on nine-foot sticks ... and at least one of them isn't even connected to a radio!

• License plate is callsign, of course.

Lifted from *NOARS LOG*, Official Publication of the Northern Ohio Amateur Radio Society.

## Add These to Your "Computerspeak" Glossary:

ATTENUATE: Response to a cannibal who's eaten the very best and asks you to rate it for him.

AUTOMATIC CHECK: The one you write every month to your software supplier.

AUTO-ANSWER: Similar to "Dial-a-Prayer," but instead of a clergyman you get Mr. Goodwrench.

AUTO-REPEAT: A key which, when held down, when held down, when held down ...

AUXILIARY MEMORY: What you go to when she doesn't believe you were working late at the office, e.g. "The train was hijacked to Cuba."

BACKWARD RECOVERY: Clintonomics.

BADGE READER: Convention-goer who gets off on reading "Hi, I'm ... " badges.

BAGBITING: What happens when you don't unwrap your sandwich.

BANKS: Quiet, air-conditioned places where your salary is automatically transferred to peripheral salesmen.

BAR CODE SCANNER: A bouncer who checks the crowd for jackets and ties.

BARREL PRINTER: The guy who writes XXX on whiskey kegs.

BASIC: Something so "simple" you need a computer to understand it.

BATCH: A minor gripe.

BATCH PROCESSING: Cleaning up a batch so you can say it in mixed company.

BAUD RATE: Fee charged by loose women; usually $5.00 and up. *(Ed. note—how does he know that?)*

BELL LABS: Large black retriever dogs that go "Ding-a-ling!" instead of "Bow wow!"

BENCHMARK: Painful creases pressed into chips from sitting for long periods on park benches.

BI-DIRECTIONAL: A computerist who swings both ways.

BINARY: A little yellow bird that waves instead of whistles.

BINARY FILE: A whole row of them.

TNX to Vince WA8BIJ and *Tuned Circuit*, L'Anse Creuse Amateur Radio Club.

**Please turn to page 86 for Tri-Ex Corporation's ad.**


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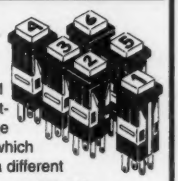

Twelve push-on/push-off switches (only 6 pictured). Each switch has a 0.6" square yellow lens with a 0.25" high black numeral 1 through 12. They are lighted by a 28 volt, #85 wedge base incandescent lamp which can be easily replaced if a different voltage is desired.

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CIRCLE 194 ON READER SERVICE CARD

# Build the QUAD-12 Personal Datalogger

Mike Gray N8KDD
1680 Cooley Lake Road
Milford MI 48381

There are several peripherals capable of converting a personal computer to a data acquisition system, but none that I know of are well suited for a laptop computer, and all of them are expensive. This quick project will be easy to assemble and to use. It's based on the new MAX186 Analog-to-Digital (A-D) converter from Maxim. You'll need only a few support components to complete the package. It's small, rugged, reliable, flexible, and cheap. Perhaps best of all, it doesn't need a battery, as the PC printer port supplies what little power it needs. The entire circuit fits in a DB-25 connector shell, including a terminal strip for connections to your various inputs.

What can you do with an A-D converter? An A-D converter lets you get information from the "outside world" into your computer. It seems that everyone has his own unique need for data acquisition. A-D converters are used in astronomy, seismology, plant growth research, and a host of other applications. An A-D converter can monitor battery voltages, RF power levels, fluid levels and pressures—practically everything can be monitored with the proper sensor. Most folks want to record temperature; this is easily accomplished with an LMØ4 temperature sensor.

## Circuit operation

The easiest way to understand the operation in this configuration is to follow the BASIC program listed in the sidebar while referring to the schematic (**Fig. 1**). In order to understand the circuit operation fully, you need a timing chart. You can get a data book from Maxim and trace the logic for each pin, then change the mode of operation once you know how it works.

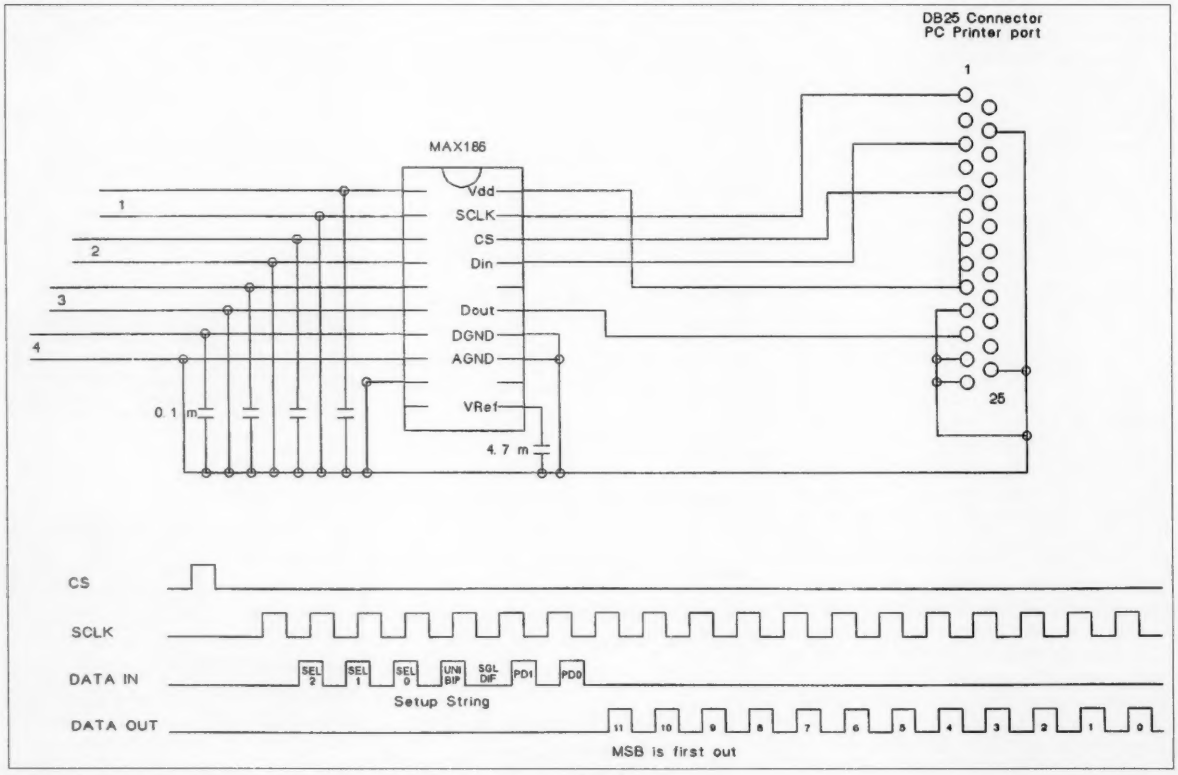


*Fig. 1. Schematic diagram and initialization timing diagram for the Datalogger.*

# MFJ-989C 3 KW Antenna Tuner

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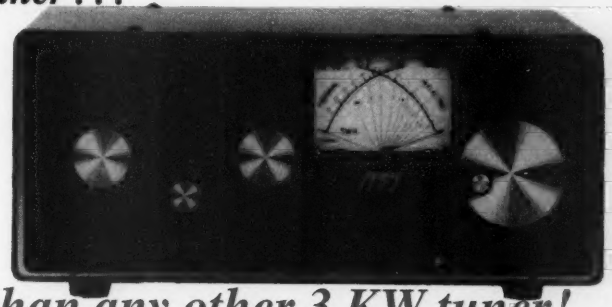

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**A** *solid* ¼ inch brass shaft with self-align bearings gives smooth non-binding rotation.

**Some** competing "legal limit" tuners use a lossy, low Q, solid core with erratic electrical contacts and have potentially damaging self-resonant frequencies. This can cause excessive heating and can destroy the core.

### Massive Transmitting Capacitors

**Look inside . . .** you'll see two *super heavy duty* transmitting variable capacitors that can handle 6000 volts. Extra wide (0.27 inch) stator plate spacing gives you arc-free operation.

**Specially** shaped plates give low minimum capacitance when unmeshed. This and a hefty 250 pf maximum give you an extremely wide matching range -- even on 160 and 10 Meters.

**The** nearest competing "legal limit" tuner has variable capacitors physically *much smaller* than the MFJ-989C's. Theirs is rated at 4500 volts -- a full *25% less* than the MFJ-989C. Theirs is more likely to arc -- *not what you want in a "legal limit" tuner!*

### Super Antenna Switch

**The** MFJ-989C *super heavy duty* antenna switch is made of *two* individual *ceramic* wafers wired in parallel. Extra wide spaced, heavy duty contacts handle extreme voltages and currents. *We've never burned one up!*

**You** can select two coax antennas (directly or through tuner), balanced line/random wire, or built-in dummy load.

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**MFJ's** *super heavy duty* 3 KW *current* balun for balanced lines uses *two* giant 2½ inch toroid cores. It's wound with *Teflon®* wire connected to high voltage *glazed ceramic* feedthrough insulators.

**The MFJ-989C** lets you safely operate high power into balanced feedlines without core saturation or voltage breakdown.

**Some** "legal limit" tuners have inferior *voltage* baluns with smaller diameter toroid cores and use soft plastic feedthrough insulators that can arc and melt.

*More reasons why the MFJ-989C is the world's finest 3 KW tuner . . .*

### Built-in Dummy Load

**A** full-size 300 watt non-inductive 50 ohm dummy load is built into the MFJ-989C.

**You'll** find it handy for transmitter tuning, testing and repairing your rig, setting power level, adjusting your mic gain and more.

**Some** "legal limit" tuners *don't* have a built-in dummy load. They want *you* to pay for an external dummy load that just gets in your way.

### Lighted *Cross-Needle* Meter

**MFJ's** lighted *Cross-Needle* SWR/Wattmeter lets you monitor SWR, forward and reflected power *simultaneously*. Read both peak and average power in two power ranges.

### Sleek and Compact

**The** compact MFJ-989C slides right into your operating position -- you'll hardly know it's there. It's just 10¾x4½x15 inches. *Do you really want a bulky "legal limit" tuner that's bigger than your amplifier?*

### *Superior* Cabinet

**The** MFJ-989C's *premium*, low-profile all-aluminum cabinet has a sub-chassis that adds strength and RFI protection.

**Every** cabinet is chemically treated and has a tough, scratch-proof vinyl cladding -- not paint that can scratch or chip off. You won't find a tougher, longer-lasting finish anywhere.

**Detailed** logging scales and legends are *permanently* silk screened on *real* aluminum front and back panels -- they aren't decals or glued-on paper strips that can peel off.

### *Superior* Construction

**Every** MFJ-989C uses PEM nuts (*not* self-tapping screws), wing-nut for ground post (*not* a cheap nut), fire-retardant epoxy glass PC board (*not* canvas based), heavy guage wire throughout (*not* small guage), locking compound on nuts/bolts (*not* loose hardware).

### *No Matter What*™ Warranty

**Every** MFJ-989C is protected by MFJ's famous one year *No Matter What*™ unconditional warranty. We will repair or replace your MFJ-989C (at our option) *no matter what* for a full year.

**Others** may give you a *limited* warranty on defects in material and workmanship.

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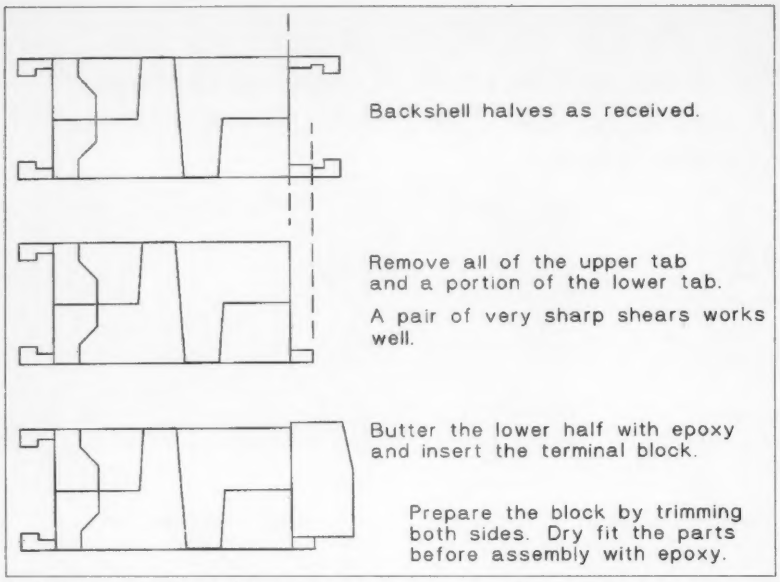
Backshell halves as received.
Remove all of the upper tab and a portion of the lower tab.
A pair of very sharp shears works well.
Butter the lower half with epoxy and insert the terminal block.
Prepare the block by trimming both sides. Dry fit the parts before assembly with epoxy.

*Fig. 2. Modifying the DB-25 backshell to allow mounting of the terminal strip.*

Although the chip has eight analog input channels, this project uses only four so it'll fit neatly within a DB-25 backshell. The channels are configured as pseudo-differential with the low pins tied to a common ground. Most measurement systems share a ground anyway, so this arrangement will work well unless there is a difference in ground potential somewhere between the computer and the transducers. I've seen this happen only in automotive applications where the computer is being charged through the lighter socket. Lighter sockets are typically grounded to the body metal, which has a ground potential about 300 mV above engine ground. If the transducers are grounded at the engine block, you have a 300 mV error. The error changes as a function of charging current. If you run the computer on its internal battery you will have no problems with ground loops.

***Photo A.** The completed QUAD-12 Datalogger.*

The 0.1 µF surface mount capacitors (C1-C4) on each input channel form crude anti-aliasing filters. They help prevent high-frequency noise from influencing the data when sampled at a relatively low rate. The MAX186 has a high input impedance. Without the capacitors, an open channel can appear very active due to static charges or electric fields.

## Software

The BASIC listing in the sidebar on page 15 shows the minimum code required to make the QUAD-12 work. You can insert it in your own application or use it just the way it is. The program simply causes the MAX186 to scan the four analog channels and print the conversion result to the screen. The source code is specific to PowerBASIC™. You may need to change the syntax or function names slightly to make it work with another version of BASIC.

After devising several application-specific programs, I wrote a generic data acquisition program for my needs. It has many of the features included in the high priced engineering software, like color graphics and mx+B scaling. It requires a 386 processor and VGA graphics. The Datalogger software is available with the complete kit of parts, or with the bare board. Check the listing at the end of this article.

## Construction

The terminal block is glued into the backshell. Most epoxies take several hours to cure, so it makes sense to start by assembling the shell first, allowing the epoxy to cure while you assemble the other components.

Using a sturdy pair of sharp scissors, cut the backshell tabs according to **Fig. 2**. Cut the small studs from the bottom of the backshell with a sharp knife or flush cutters. I've found that the flush cutters work best. Trim the sides of the terminal block until it fits snugly into the backshell. When you are happy with the fit, apply some epoxy to both parts and clamp them in place until the glue is cured. Trim the circuit board with a file or grinder. The board supplied with the kit is a little larger than it needs to be, due to an artifact of the manufacturing process. The board fits snugly between the pins of the DB-25 connector.

Solder all five surface mount capacitors to the board. If you have never installed a surface mount component, don't be intimidated—it's really quite easy. Pre-tin one pad with enough solder to form a bead slightly larger than the end of the component. Position the component, apply a little pressure, and reflow the solder until it wicks up the side. Solder the other pad, then check your work. If the solder joint doesn't shine, add a little solder. Once you get a feel for how much solder to pre-tin the board with, you won't need to resolder any joints. All it takes is a little practice.

Bend the pins on the A-D converter (IC-1) outward until they are horizontal. Trim the pins so they fit within the confines of the board. Referring to **Figs. 3**

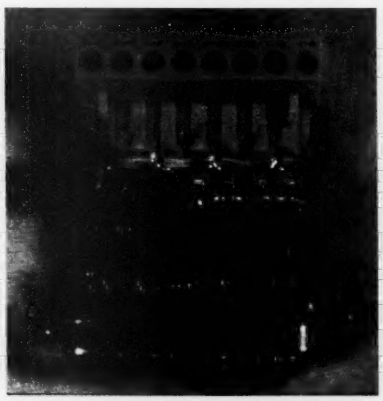

***Photo B.** Internal view of the QUAD-12, showing the surface mount soldering.*

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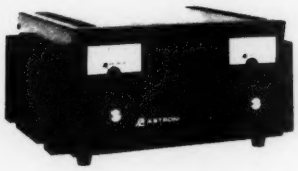


MODEL VS-50M

### SPECIAL FEATURES

- SOLID STATE ELECTRONICALLY REGULATED
- FOLD-BACK CURRENT LIMITING Protects Power Supply from excessive current & continuous shorted output
- CROWBAR OVER VOLTAGE PROTECTION on all Models except RS-3A, RS-4A, RS-5A, RS-4L, RS-5L
- MAINTAIN REGULATION & LOW RIPPLE at low line input Voltage
- HEAVY DUTY HEAT SINK • CHASSIS MOUNT FUSE
- THREE CONDUCTOR POWER CORD except for RS-3A
- ONE YEAR WARRANTY • MADE IN U.S.A.

### PERFORMANCE SPECIFICATIONS

- INPUT VOLTAGE: 105-125 VAC
- OUTPUT VOLTAGE: 13.8 VDC ± 0.05 volts (Internally Adjustable: 11-15 VDC)
- RIPPLE Less than 5mv peak to peak (full load & low line)
- All units available in 220 VAC input voltage (except for SL-11A)

## SL SERIES

• LOW PROFILE POWER SUPPLY

| MODEL | Colors Gray | Colors Black | Continuous Duty (Amps) | ICS* (Amps) | Size (IN) H × W × D | Shipping Wt. (lbs.) |
|---|---|---|---|---|---|---|
| SL-11A | • | • | 7 | 11 | 2⅝ × 7⅞ × 9¾ | 12 |
| SL-11R | • | • | 7 | 11 | 2⅝ × 7 × 9¾ | 12 |
| SL-11S | • | • | 7 | 11 | 2⅝ × 7⅞ × 9¾ | 12 |
| SL-11R-RA | | • | 7 | 11 | 4¾ × 7 × 9¾ | 13 |

## RS-L SERIES

• POWER SUPPLIES WITH BUILT IN CIGARETTE LIGHTER RECEPTACLE

| MODEL | Continuous Duty (Amps) | ICS* (Amps) | Size (IN) H × W × D | Shipping Wt. (lbs.) |
|---|---|---|---|---|
| RS-4L | 3 | 4 | 3½ × 6⅛ × 7¼ | 6 |
| RS-5L | 4 | 5 | 3½ × 6⅛ × 7¼ | 7 |

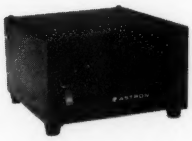
## RM SERIES

MODEL RM-35M

• 19" RACK MOUNT POWER SUPPLIES

| MODEL | Continuous Duty (Amps) | ICS* (Amps) | Size (IN) H × W × D | Shipping Wt. (lbs.) |
|---|---|---|---|---|
| RM-12A | 9 | 12 | 5¼ × 19 × 8¼ | 16 |
| RM-35A | 25 | 35 | 5¼ × 19 × 12½ | 38 |
| RM-50A | 37 | 50 | 5¼ × 19 × 12½ | 50 |
| RM-60A | 50 | 55 | 7 × 19 × 12½ | 60 |
| • Separate Volt and Amp Meters | | | | |
| RM-12M | 9 | 12 | 5¼ × 19 × 8¼ | 16 |
| RM-35M | 25 | 35 | 5¼ × 19 × 12½ | 38 |
| RM-50M | 37 | 50 | 5¼ × 19 × 12½ | 50 |
| RM-60M | 50 | 55 | 7 × 19 × 12½ | 60 |

## RS-A SERIES



MODEL RS-7A

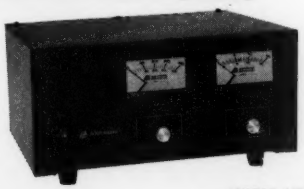
| MODEL | Colors Gray | Colors Black | Continuous Duty (Amps) | ICS* (Amps) | Size (IN) H × W × D | Shipping Wt. (lbs.) |
|---|---|---|---|---|---|---|
| RS-3A | | • | 2.5 | 3 | 3 × 4¾ × 5¾ | 4 |
| RS-4A | • | • | 3 | 4 | 3¾ × 6½ × 9 | 5 |
| RS-5A | | • | 4 | 5 | 3½ × 6⅛ × 7¼ | 7 |
| RS-7A | • | • | 5 | 7 | 3¾ × 6½ × 9 | 9 |
| RS-7B | • | • | 5 | 7 | 4 × 7½ × 10¾ | 10 |
| RS-10A | • | • | 7.5 | 10 | 4 × 7½ × 10¾ | 11 |
| RS-12A | • | • | 9 | 12 | 4½ × 8 × 9 | 13 |
| RS-12B | | • | 9 | 12 | 4 × 7½ × 10¾ | 13 |
| RS-20A | • | • | 16 | 20 | 5 × 9 × 10½ | 18 |
| RS-35A | • | • | 25 | 35 | 5 × 11 × 11 | 27 |
| RS-50A | • | | 37 | 50 | 6 × 13¾ × 11 | 46 |
| RS-70A | • | | 57 | 70 | 6 × 13¾ × 12⅛ | 48 |

## RS-M SERIES

MODEL RS-35M

| MODEL | Continuous Duty (Amps) | ICS* (Amps) | Size (IN) H × W × D | Shipping Wt. (lbs.) |
|---|---|---|---|---|
| • Switchable volt and Amp meter | | | | |
| RS-12M | 9 | 12 | 4½ × 8 × 9 | 13 |
| • Separate volt and Amp meters | | | | |
| RS-20M | 16 | 20 | 5 × 9 × 10½ | 18 |
| RS-35M | 25 | 35 | 5 × 11 × 11 | 27 |
| RS-50M | 37 | 50 | 6 × 13¾ × 11 | 46 |
| RS-70M | 57 | 70 | 6 × 13¾ × 12⅛ | 48 |

## VS-M AND VRM-M SERIES



MODEL VS-35M

• Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

| MODEL | Continuous Duty (Amps) @13.8VDC | @10VDC | @5VDC | ICS* (Amps) @13.8V | Size (IN) H × W × D | Shipping Wt. (lbs.) |
|---|---|---|---|---|---|---|
| VS-12M | 9 | 5 | 2 | 12 | 4½ × 8 × 9 | 13 |
| VS-20M | 16 | 9 | 4 | 20 | 5 × 9 × 10½ | 20 |
| VS-35M | 25 | 15 | 7 | 35 | 5 × 11 × 11 | 29 |
| VS-50M | 37 | 22 | 10 | 50 | 6 × 13¾ × 11 | 46 |
| VS-70M | 67 | 34 | 16 | 70 | 6 x 13¾ x 12⅛ | 48 |
| • Variable rack mount power supplies | | | | | | |
| VRM-35M | 25 | 15 | 7 | 35 | 5¼ × 19 × 12½ | 38 |
| VRM-50M | 37 | 22 | 10 | 50 | 5¼ × 19 × 12½ | 50 |

## RS-S SERIES

MODEL RS-12S

• Built in speaker

| MODEL | Colors Gray | Colors Black | Continuous Duty (Amps) | ICS* Amps | Size (IN) H × W × D | Shipping Wt. (lbs.) |
|---|---|---|---|---|---|---|
| RS-7S | • | • | 5 | 7 | 4 × 7½ × 10¾ | 10 |
| RS-10S | • | • | 7.5 | 10 | 4 × 7½ × 10¾ | 12 |
| RS-12S | • | • | 9 | 12 | 4½ × 8 × 9 | 13 |
| RS-20S | • | • | 16 | 20 | 5 × 9 × 10½ | 18 |
| SL-11S | • | • | 7 | 11 | 2¾ x 7⅞ x 9¾ | 12 |

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

CIRCLE 16 ON READER SERVICE CARD

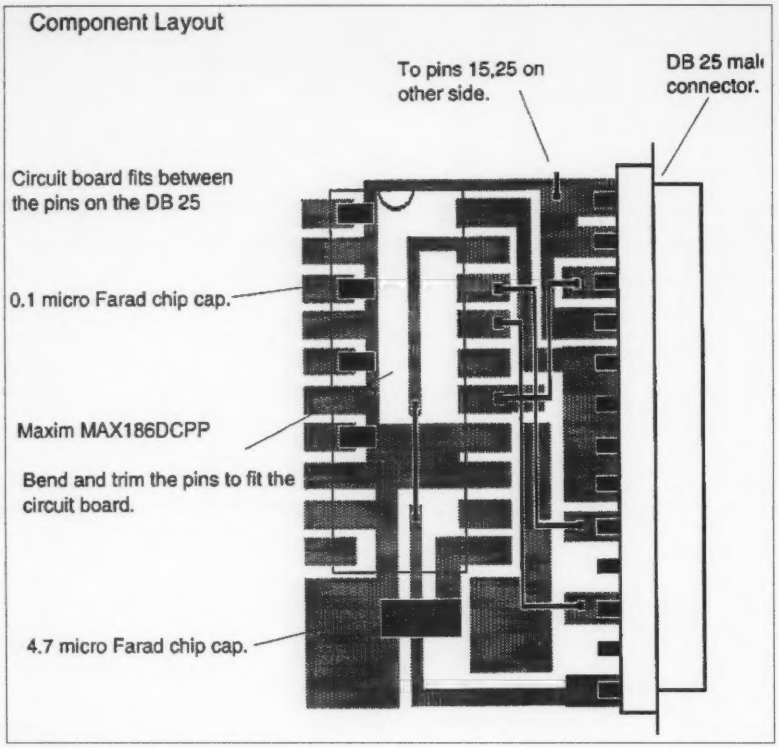

Component Layout
To pins 15,25 on other side.
DB 25 mal connector.
Circuit board fits between the pins on the DB 25
0.1 micro Farad chip cap.
Maxim MAX186DCPP
Bend and trim the pins to fit the circuit board.
4.7 micro Farad chip cap.

*Fig. 3. Parts placement diagram.*

and **4**, solder the A-D chip to the board.

Slide the circuit board between the pins of the DB-25 connector and check to be sure that the assembly fits the backshell. You may need to do some trimming. Solder the DB-25 pins to the board, filling the solder cups completely.

Solder the four connecting wires. Hold a stripped wire against the proper DB-25 solder cup and heat the cup until the wire slides into the cup. Add a little solder if necessary. Install the jumper wire under IC-1.

Using 20 gauge bus wire, connect all the ground terminals to the circuit board ground plane. The wire fits snugly in the terminal block, and no solder is required, except on the circuit board. Connect pins 25 and 15 of the DB-25 to the ground plane too.

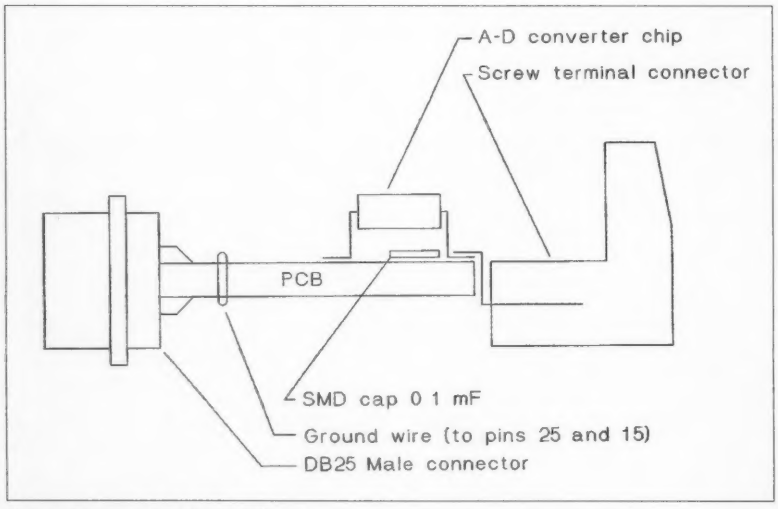



*Fig. 4. Construction detail, side view.*

Connect the individual input channels to the appropriate pins on the A-D chip. Refer to **Fig 1**.

After checking your work, you can give the instrument a try! Run the program listed in the sidebar, and apply a DC signal to each channel. Vary the signal amplitude from zero to 4.096 volts, and verify that an accurate conversion result appears on the screen.

If it doesn't work, change the base port address from 888 to 956. Most portable computers have the printer port at 888, but Compaq is 956. You can run a diagnostic program to find out for sure which address your computer uses (my software allows you to change the port address with a single keystroke).

With the testing complete, you can make the assembly permanent. Fill the backshell cavity with epoxy or RTV silicone. Snap the top half of the backshell in place and allow the fill material to cure overnight. The kit includes a plastic label for the terminal block. Trim it to fit in the flat the area below the terminal screws. Remove the protective backing and apply the label to the terminal block. You may need to trim any excess with a sharp knife. Once the epoxy sets, you're ready to take out your laptop and start monitoring the "outside world."

**PARTS LIST**

**All capacitors are surface mount:**

C1-C4 0.1 µF (Digi-Key # PCS6104CT)
C5 4.7 µF

**Semiconductors:**

IC1 (Maxim MAX186DCPP Serial A-D)

**Miscellaneous:**

DB-25 Male connector (Norwesco or Cinch)
DB-25 Backshell (Norwesco TT model 925M)
Circuit board (Author)
8-position terminal block (On-Shore Technology ED1707)
4 inches of 20-gauge tinned solid wire
4 inches of 22-gauge solid core hookup wire

A kit including all components and software is available for $80. The kits do *not* include epoxy or silicone. A bare circuit board is available for $3. The Datalogger software is $10, and a circuit board is included. Contact: Mike Gray N8KDD, 1680 Cooley Lake Road, Milford MI 48381; (810) 685-9248.

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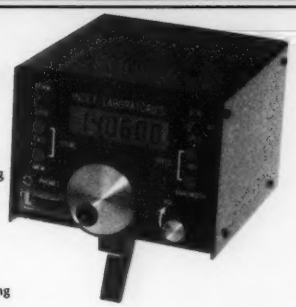

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## BASIC PROGRAM

```
port%=888                               'port%=888 for most computers.
port1%=port%+1                          'port%=956 for Compaq
port2%=port%+2
   out port2%,1
MINORLOOP:
 while not instat
  for ch%=0 to 3                        'Scan 4 channels
     out port%,248                      'CS high  pin 5
     out port%,240                      'CS low
     out port%,242                      'start bit is always high DI line
     out port2%,0                       'clock high pin 1 of DB 25 printer
     out port2%,1                       'clock low

     out port%,sel2%                    'SEL 2
     out port2%,0                       'clock high
     out port2%,1                       'clock low

     out port%,sel1%                    'SEL 1
     out port2%,0                       'clock high
     out port2%,1                       'clock low

     out port%,sel0%                    'SEL 0
     out port2%,0                       'clock high
     out port2%,1                       'clock low

     out port%,242                      'UNI/BIP
     out port2%,0                       'clock high
     out port2%,1                       'clock low

     out port%,240                      'SGL/DIF  DIF selected
     out port2%,0                       'clock high
     out port2%,1                       'clock low

     out port%,242                      'PD1
     out port2%,0                       'clock high
     out port2%,1                       'clock low

     out port%,242                      'PD0 (lab)
     out port2%,0                       'clock high
     out port2%,1                       'clock low

READBITS:
      for bit%=11 to 0 step -1          'MSB is first out
       out port2%,0                     'clock high
       out port2%,1                     'clock low
       if inp(port1%)<120 then byte%=byte%+(2^bit%)
       next bit%

     if ch%=0 then sel2%=240:sel1%=240:sel0%=242:ch0volts=byte%/1000
     if ch%=1 then sel2%=240:sel1%=242:sel0%=240:ch1volts=byte%/1000
     if ch%=2 then sel2%=240:sel1%=242:sel0%=242:ch2volts=byte%/1000
     if ch%=3 then sel2%=240:sel1%=240:sel0%=240:ch3volts=byte%/1000
     byte%=0
  next ch%
  print using "####.####  ";ch0volts,ch1volts,ch2volts,ch3volts
  delay .5
  wend
```

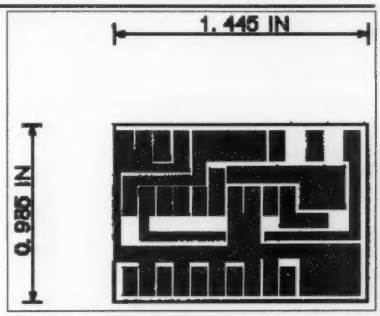


*Fig. 5. Full-size PC board template.*

*Continued on page 27*


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CIRCLE 160 ON READER SERVICE CARD

# Vee Antenna With Vertical Tails

*A multiband antenna with low-angle radiation for the low bands.*

Nizar A. Mullani KØNM
719 Santa Maria
Sugar Land TX 77478
E-mail:
nmullani@heart.med.uth.tmc.edu

As we languish in the minimum in solar sunspot cycle, the major part of high-frequency communications is going to be carried out in the 30, 40, and 80 meter bands for the next couple of years. Horizontally polarized antennas for these bands have to be installed in excess of 50 feet in height to obtain the low angle of radiation necessary for DX work. Vertically polarized antennas, such as a quarter-wave ground-plane, are excellent for transmitting but poor for receiving on the low bands. Moreover, an excellent ground is required for ground-plane antennas to work well. If you are limited in the height of the antenna, then obtaining low angle radiation on the low bands becomes quite difficult.

### Vee-with-tails design

A design that overcomes some of these limitations is the vee antenna modified to include vertical tails. The vee is an excellent multiband antenna in which two equal lengths of wire are formed in a vee configuration and fed with parallel-line tuned feeders at the apex of the vee. At low frequencies, the horizontal wires have to be fairly high in order to provide a low angle of radiation on the low bands.

In my design, the vee-beam antenna wire has vertical tails added at each end, reaching almost to the ground. These two vertical radiators behave like two 180° out-of-phase verticals fed at the top with current maximums above the ground. The horizontal wires of the vee antenna provide medium range reception, while the vertical tails provide the low angle of radiation necessary for DX. At high frequencies, the vee horizontal wires provide excellent gain and directivity.

### Computer simulations of the vee-with-tails

Several different antenna designs with varying heights and lengths were simulated using the AO antenna simulation program. A wide range of lengths for the vee-with-tails were designed, based on the size of the lot available for placing the antenna. Some of these designs are listed in **Table 1**.

The longer the horizontal wire, the more the gain at high frequencies. However, the height of the antenna becomes critical at anything over 45 feet because long vertical wires tend to radiate at high angles when their lengths become longer than one-half wavelength at the operating frequency. This basically relegates the design of the multiband vee beam with tails to antennas approximately 35 to 45 feet high. However, a design of this antenna optimized for the 80 meter band would benefit from longer vertical wires, higher antenna height, and a larger included angle between the wires. The ideal length of the vertical wires was found to be one half the wavelength at the operating frequency, though shorter lengths also work well.

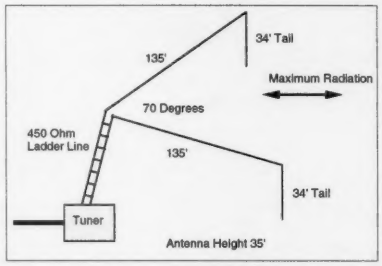


***Fig. 1** The horizontal wires are 135 feet long and are formed into a vee with an included angle of 70°. Vertical tails, each 34 feet long, are added at both ends to provide the low angle of radiation from the two top-fed, out-of-phase vertical radiators. The antenna is fed with parallel wire feeders, such as 450 ohm ladder line, and matched to the transmitter with a tuner or a 9 to 1 balun. Alternatively, it can be matched with a 9 to 1 or 16 to 1 balun at the feed point and fed with coax. Different lengths and sizes of the vee-with-tails designs are shown in **Table 1**.*

### Test antenna

I built a test antenna with 135-foot horizontal components and 34-foot vertical tails, as shown in **Fig. 1**. The total height of the antenna was 35 feet, with an included

| Type of Antenna | Leg Length (ft.) | Vee Angle (Deg.) | Tail Length (ft.) |
|---|---|---|---|
| Author's Test Antenna | 135 | 70 | 34 |
| G5RV Vee with Tails | 51 | 120 | 24 or 34 |
| Short Vee with Tails | 82 | 100 | 34 |
| 80 Meter Dipole | 67 | 180 | 24 |

***Table 1**. Some variations of the antenna designs that I've simulated on my computer. All antennas were simulated at a height of 35 feet. The length of the vertical tails can be decreased to 24 feet if necessary.*

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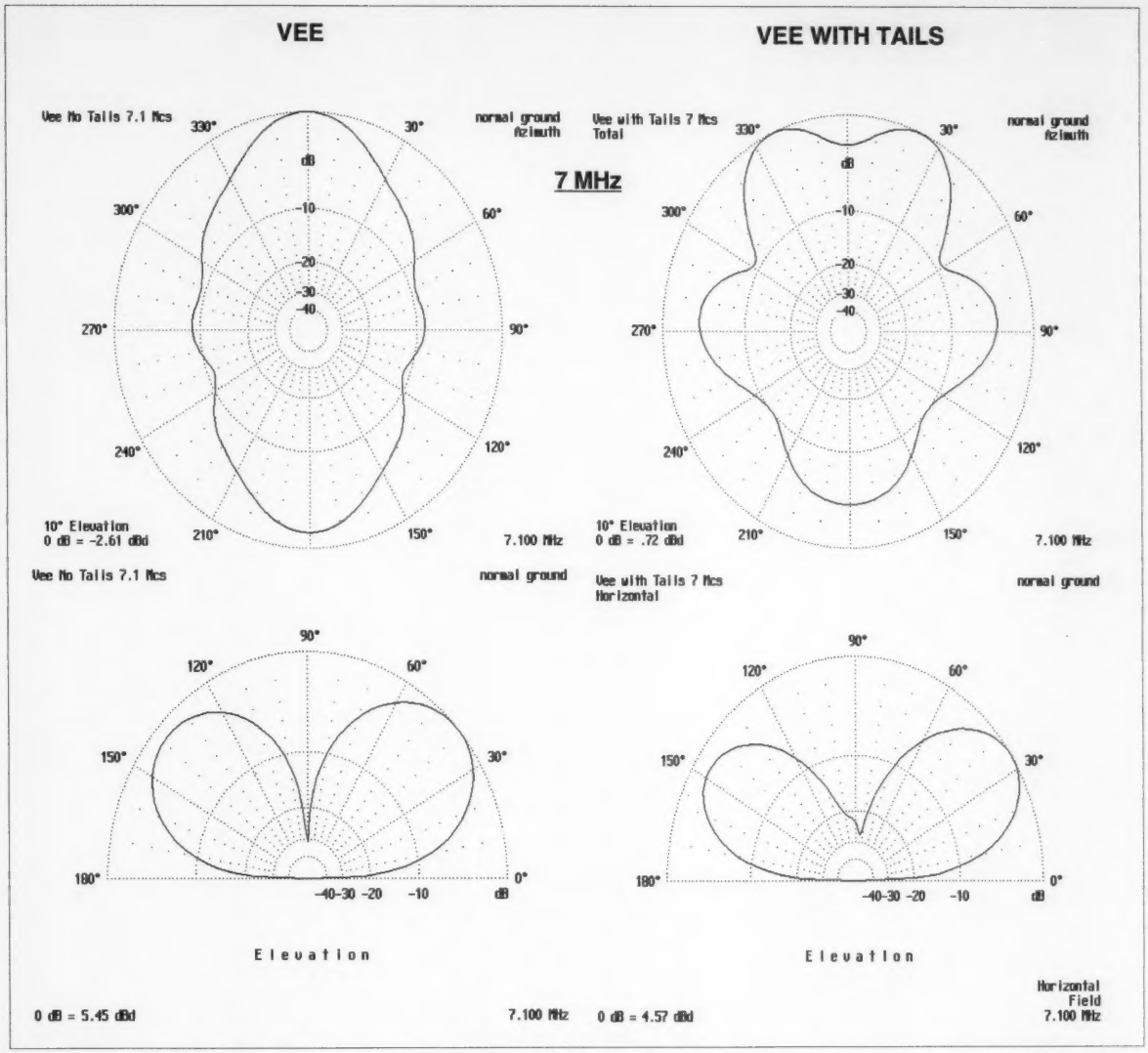


*Fig. 2. Computer generated radiation patterns for the conventional vee and the vee-with-tails for the test antenna shown in* ***Fig. 1.*** *The total field pattern is shown for an elevation angle of 10°, and the azimuth angle is chosen at the maximum point in the radiation. The angle of radiation for the vee-with-tails is approximately 10° lower than the conventional vee.*

angle of 70°. The antenna was fed with 450 ohm ladder line and a 9 to 1 balun at the transceiver. The automatic tuner in the Icom IC-738 was able to tune this antenna from 10 through 160 meters.

Final trimming of the SWR was carried out by trimming the length of each vertical wire equally. If a tuner is used between the transmitter and the 450 ohm ladder line, the length of the vee is not critical. Shorter horizontal lengths can be used, provided the included angle is made larger (see **Table 1**). Shorter vertical radiators can also be used.

***"I built and tested this antenna in one afternoon with the help of my 10-year-old son."***

### Computer-generated radiation patterns for the test antenna

The test antenna design was optimized for the 30 meter band so it would work well from 80 to 10 meters. Computer-generated field-strength patterns comparing the horizontal vee and the vee-with-tails are shown in **Fig. 2**, for the 40 meter band. Note the broader radiation pattern of the of the vee-with-tails. The vee-with-tails has approximately a 10° lower angle of radiation due to the tails. The vertical radiation is compared to a simple ground-plane antenna in **Fig. 3,** which also shows the horizontal pattern. Note that two major lobes are formed for the vertical radiation. These combine with the horizontal radiation to provide a wide angle of coverage in the direction of the vee on 40 meters.

At high frequencies, the vertical wires radiate at high angles; however,

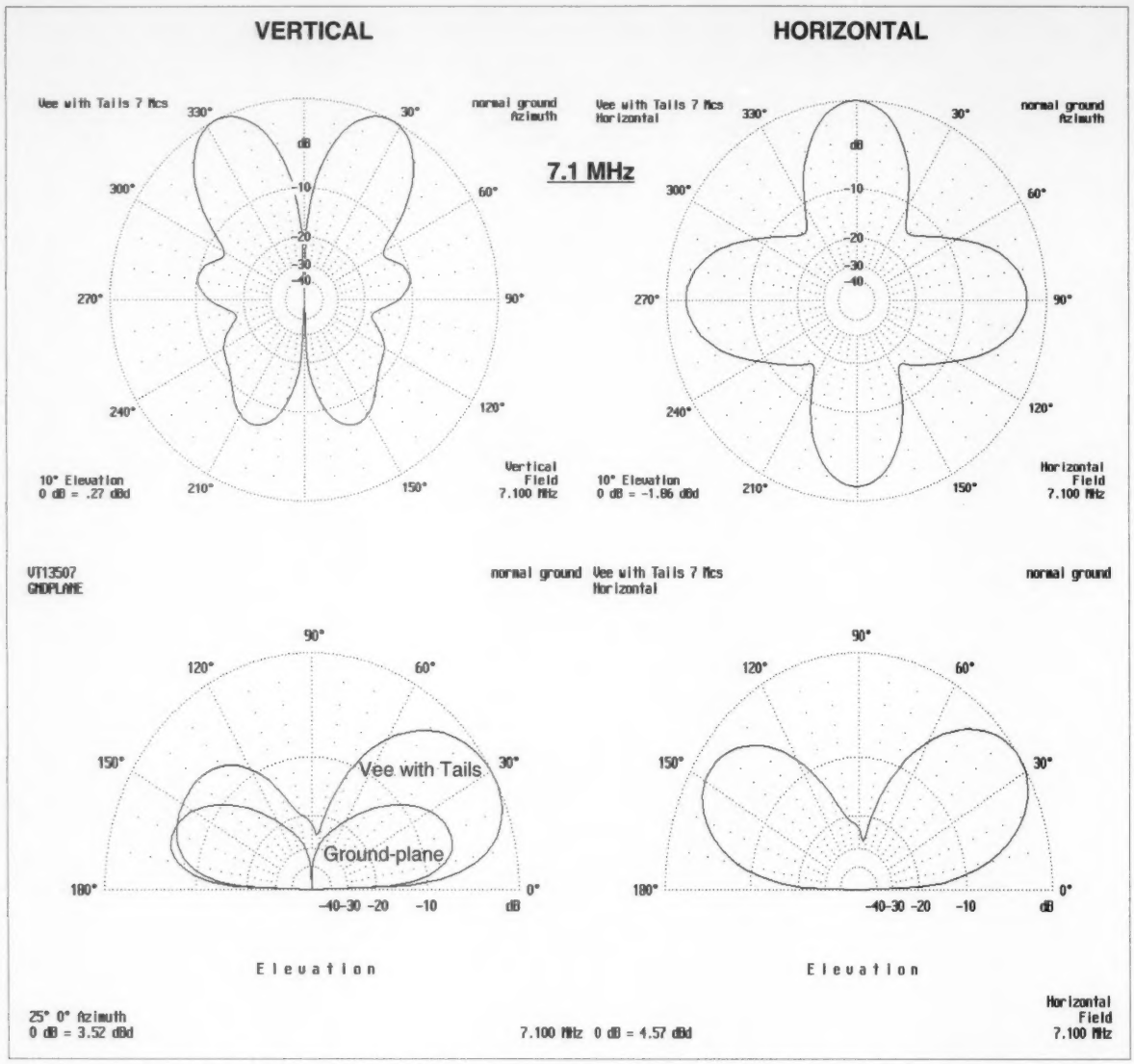


*Fig. 3. A comparison of the vertical and horizontal polarization pattern for the vee-with-tails test antenna on 40 meters. The vertically polarized radiation pattern has two lobes and the major field strength is stronger than the ground-plane radiation in the direction of the vee. The ground-plane radiation pattern is superimposed on the vertical elevation graph.*

the horizontal vee provides a fair amount of gain to compensate for the loss from the vertical radiators.

**Fig. 4** shows the computer-generated radiation patterns for the 20, 15, and 10 meter bands. The patterns are equivalent to a three-element beam at low heights. And, even though the 17 and 24 meter data are not shown, the antenna works quite well on these bands too.

On 80 meters, the radiation pattern is dominated by the low height of the horizontal wires, which puts most of the radiation at a high angle. However, even at this low height, some low angle of radiation takes place on 80 meters, as shown in **Fig. 5**. Note, however, that the maximum radiation pattern for the vertical components in the 80 meter band is at right angles to the direction of the vee. At this frequency, the two out-of-phase vertical radiators are separated by approximately one-half wavelength and the maximum radiation pattern is in line with the two vertical elements.

***"I've had a lot of fun with this antenna, especially since it is concealed among my trees and the neighbors don't even know that it exists."***

**Test results for the vee-with-tails**

The test antenna has been used for two winters and in several contests. It was tested against a quarter-wave trap vertical antenna with ground radials as a standard. In the optimum direction of

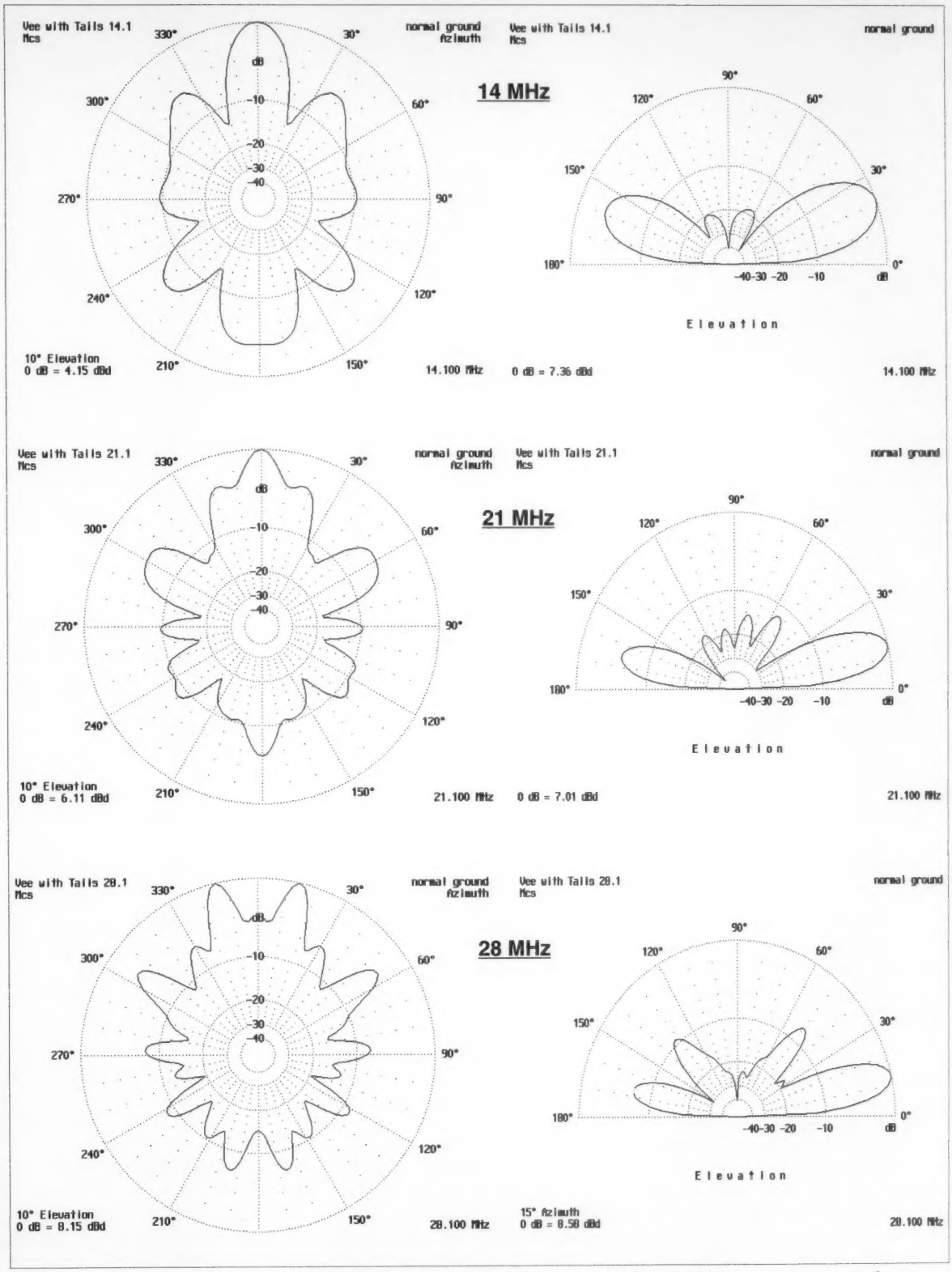


*Fig. 4. Computed field strength patterns for the antenna on the 20, 15, and 10 meter bands. These radiation patterns are very similar to a vee without tails, except that the gain is slightly lower for the vee-with-tails due to some high angle radiation at these frequencies from the vertical radiators.*

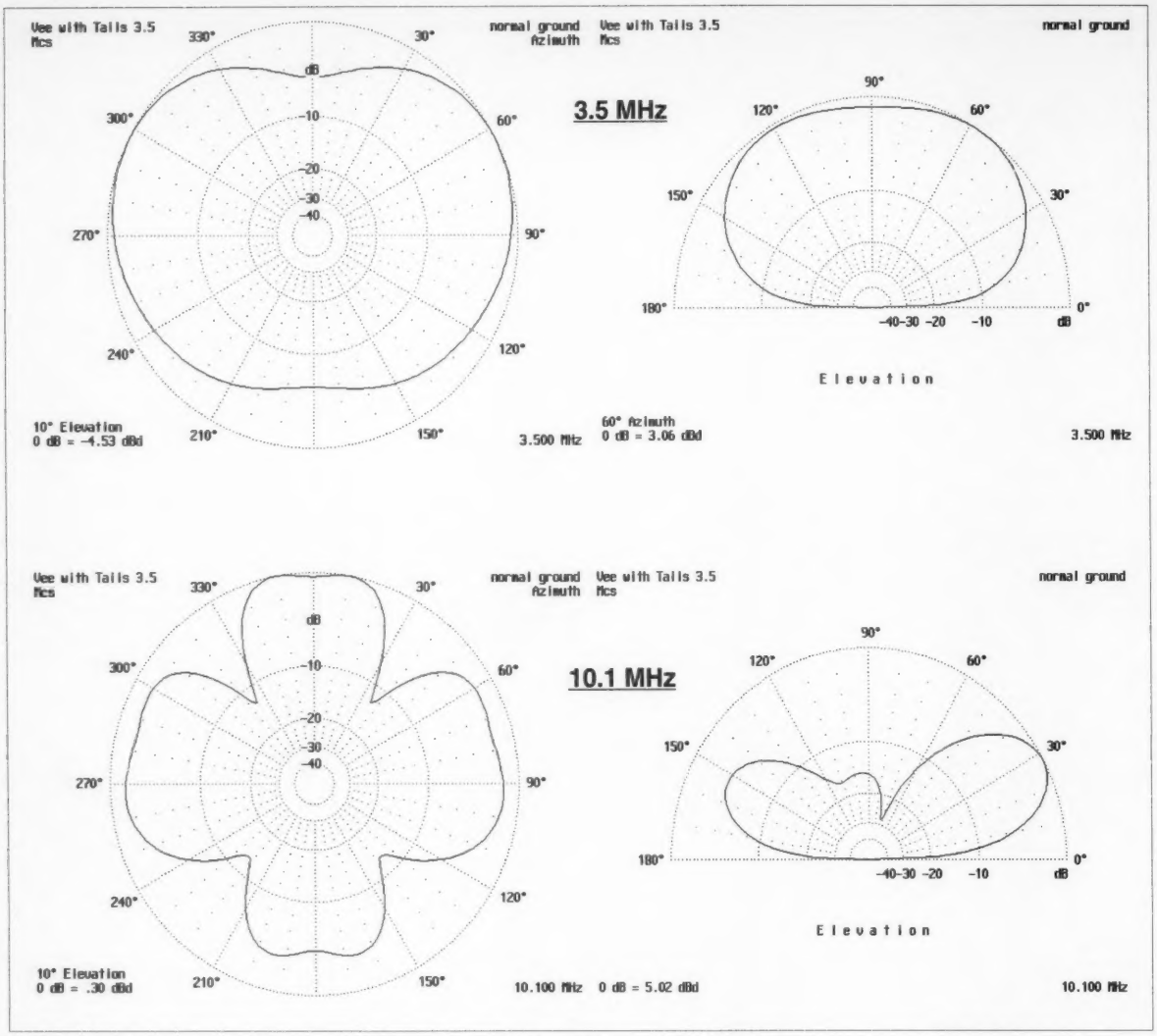


*Fig. 5. Computed field strength patterns for the antenna on the 80 and 30 meter bands. Note that the maximum radiation on 80 meters occurs at 90° to the direction of the vee.*

the vee antenna, which is north-northeast from Houston, Texas, this antenna consistently outperformed the vertical by two or more S-units on 40 meters. Received signal strengths at the other stations were also compared for the vertical and the vee beam with tails. Again, in the direction of the vee, the beam with tails performed two or more S-units better. Fading was reported to be much less, both for the received and transmitted signals, partly because of the mixed horizontal and vertical polarization of the antenna. QRP operation with 2 watts on 40 meters was a snap into the northeast United States and Mexico, with 579 signals. Signal strengths at 90° to the orientation of the vee were better for the ground-plane antenna than for the vee-with-tails.

Working contests was also quite easy with this multiband design. I worked most of the European and North American stations that I heard. On 20 meters, the antenna could not compare to the big yagi antennas on tall towers. However, it consistently put out a very strong signal into the northeast and Europe, comparable to a triband-type yagi antenna at a low height. During a couple of contests, when the 15m band was open to Europe, the antenna put out a very strong signal. On 80m the maximum vertical radiation is 90° from the direction of the vee. South American contacts were 579 with 100 watts, while short-skips to the US provided strong signals. I even loaded up the antenna on 160 meters during the last contest and worked 25 states in a couple of hours.

## Conclusions

Considering that this antenna is designed for multiband operation and is only 35 feet off the ground, it works remarkably well. The antenna is easy to build and the tails can be adjusted for the best compromise in SWR across the bands. I built and tested this antenna in one afternoon with the help of my 10-year-old son, Ethan. The 9 to 1 balun can be replaced with an antenna tuner if desired. It is also possible to place a 16 to 1 ratio balun at the feed point and run 50

ohm coax to the tuner. A 16 to 1 balun provides a better match overall if the 450 ohm ladder line is not used.

The only critical parameter in the antenna design is the angle of the vee; that's what determines the radiation pattern at different frequencies. The shorter the horizontal length of the antenna, the greater the included angle in the vee should be. As an example, the G5RV version of the vee beam with tails has 51-foot horizontal wires with 34-foot vertical wires, and an included angle of 120°. This design works quite well on 40 and 80 meters and provides some low-angle of radiation that is not available from a conventional G5RV oriented in the horizontal direction.

The vee is very simple to construct if you have some trees in your back yard. There are several variations of the lengths and angles for this antenna which can accommodate different sized lots. The critical thing in the construction is to keep the two sides of the vee the same length. And, since wire antennas are more susceptible to damage, record the SWRs on all the bands for future reference. This way, if you suspect some damage you can easily check it with an SWR measurement.

I've had a lot of fun with this antenna, especially since it is concealed among my trees and the neighbors don't even know that it exists.

**References**


1. *The ARRL Antenna Handbook,* 1995

2. AO and NEC programs published by Brian Beezley K6STI. 73



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## Build the QUAD-12

*Continued from page 15*

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2. *Don't forget the Nyquist theorem.* Set the sample interval to least twice the highest frequency you expect to see. If you don't, you may be sampling only peaks or valleys.

3. *Don't lose data.* Write data only to a RAM disk or hard drive. Floppy drives are slow and you may miss a record or ruin your time base during disk writes. Floppy drives should be fast enough for sample intervals greater than 3 seconds.

4. *Don't let unused input pins float.* Connect unused channels to ground. Generally speaking, high input impedance is a good thing because the measurement system doesn't load the system under test. An open channel is measuring the electrical potential of the air, with respect to the ground plane of the computer. It's possible for high voltage on an open channel to affect an adjacent in-use channel. 73


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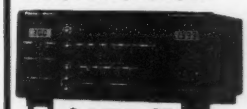

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I suspect there are a lot of Kenwood TS-50 owners who, like me, use this radio at home as much as they do in their cars. For its size, the radio packs in a lot of features, but one is missing: a way to enter frequency directly from a PC.

Like many current rigs, the TS-50 includes provisions for connecting a computer for direct frequency entry capability, but I didn't like their approach because it requires an outboard box with a cable coming out through the bottom of the radio. That's not my idea of something portable. The ideal would be to use a portable computer and a cable that easily connects to the rig, with no other baggage necessary. I accomplished this using a notebook computer with an easily built in-line interface and a simple control program.

### Tying into the radio

After studying the TS-50's schematic, I could see that it was essentially computer-ready. The microprocessor used in the '50 is one of the newer breed of microcontrollers that include a UART (Universal Asynchronous Receiver-Transmitter) built in. **Fig. 1** is a partial diagram showing the TS-50's computer interface circuit details. In implementing computer control for this radio it looked as if I'd have to add some buffering, level conversion, and signal inversion, and come up with some scheme so that I could connect to "CN6," as shown in **Fig. 1**. CN6 is the serial data interface connector, and supplies TX and RX data, handshaking, and a 5-volt power source.

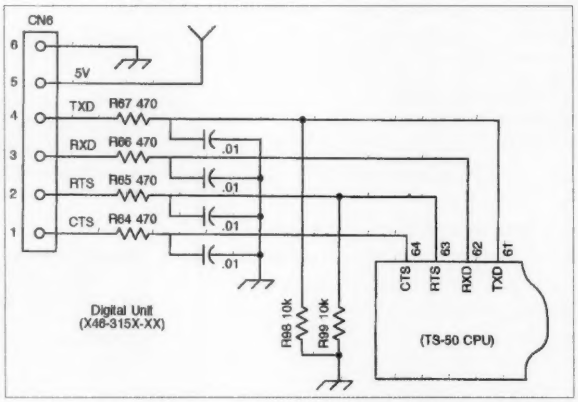


*Fig. 1. Partial diagram showing the control computer interface circuits.*

The rear panel of the TS-50 didn't leave room to add a new connector, but I noticed that the heat sink was tapered at the top rear on either side, leaving enough room to sneak a 1/8-inch cable out the back. This would let me hook up some type of in-line connector with which I could connect my computer. **Photo A** shows the 1/8-inch, three-circuit miniphone type connector I used.

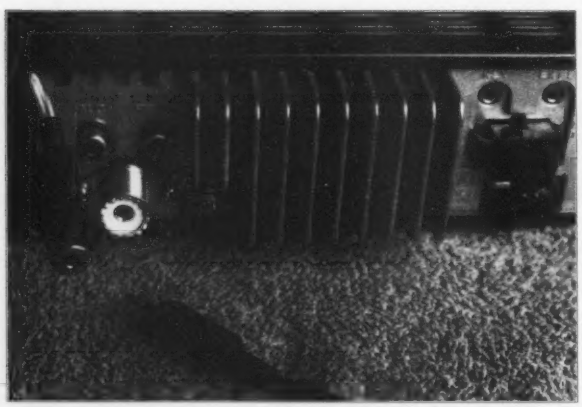

*Photo A Rear panel view showing the added computer interface cable and connector.*

I had easily passed the cable out of the radio, but I still had to make a connection at CN6 on the radio's microprocessor board. CN6 appears to be what I call a "mini-header connector," and finding anything that would mate with it in my neighborhood proved impossible. If you can find a mating connector, I would recommend using it—I decided to go without a connector. **Photo B** shows the technique I used to connect to CN6.

At first, I considered soldering wires directly to the circuit board points at CN6 (this is an option), but, in keeping with my preference to make no mechanical modifications (and possibly void any warranty), I elected to take a somewhat unorthodox approach. I selected three lengths of #22 stranded hookup wire that were long enough to run from CN6 to the rear of the radio. I then cut the CN6 ends of the wire square and carefully bored holes into the ends of each wire using a straight pin (see **Fig. 2**). The wires were then pushed over the appropriate pins of CN6, as shown in **Photo B**.

To complete the installation, I cut a small rectangle of electrical tape and carefully stuffed it between my wires and the inside of the connector's plastic shell, sticky side out (using a small screwdriver). This tape wedge provides a slight amount of "spring tension" to push the wires against the CN6 pins for good electrical contact, and it acts as an adhesive to hold the wires into CN6. Should I ever want to de-install this "modification," I'll simply pull the wires and tape out of the radio, leaving no traces of any work I've done.

I routed the wires through a small chassis opening adjacent to CN6, to the outside along the right side of the radio, and finally out the rear near the top right of the radio. To protect the wires, I ran them inside a piece of 1/8-inch diameter plastic tubing for added insulation. This is not essential, but it's a good idea to use electrical tape or something at potential "pinch-points." Outside the radio, I terminated the wires with a 1/8-inch diameter three-circuit female in-line mini-phone jack, wired per **Fig. 3.**

Check carefully to make sure there are no straggling wire strands anywhere, especially down inside CN6, since it also carries +5 VDC and ground. I used a magnifying glass and made ohmmeter checks to make sure I didn't have any problems. Also make sure the cable is tied off properly to prevent strain from being transferred to CN6.

### The level converter interface

I decided to do a three-wire RS-232 implementation, even though the TS-50 supports hardware handshaking via RTS and CTS at CN6. The main reason was so I could use that small, unobtrusive connector outside the radio. Also, it kept the interface simpler, and I wanted an "in-line" device. **Fig. 3** is a diagram of the level converter interface design I developed for the TS-50, together with interconnecting wiring details. **Photo C** shows how I built it as an in-line device, part of the interconnecting cable between my computer and the TS-50.

Having done a similar interface to another type radio, I was a bit concerned about the lines from CN6 in this radio because they run directly to the radio's microprocessor—no buffers or the like (see **Fig. 1**). Any static discharge or improper voltage that came in on my cable


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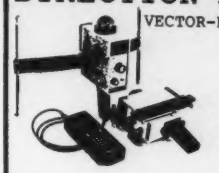

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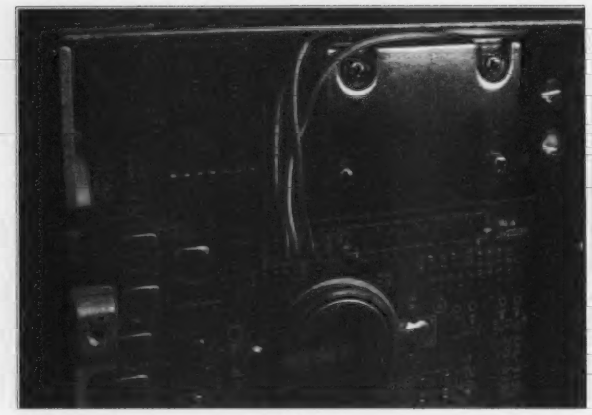

***Photo B**. Direct connection technique used with "CN6" on the microprocessor board (see text).*

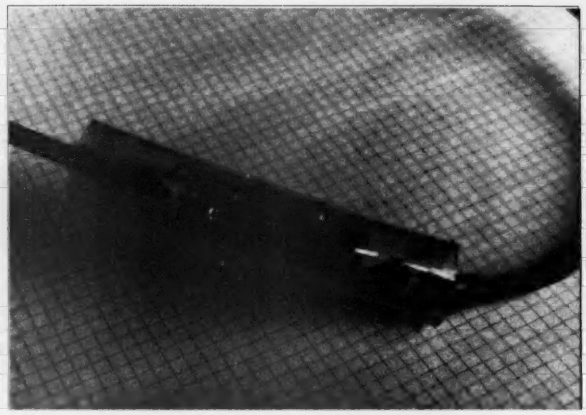

***Photo C**. Construction details of the RS-232 interface cable.*

could do serious damage. To make this installation a little less static-sensitive, I decided to add a 10k pull-down resistor to the RxD line, similar to the one on TxD. I installed this resistor inside the shell of the mini-phone jack from the radio, as shown in **Fig. 3**. Too bad they didn't include a pull-up resistor at RxD inside the radio; it would have made my level converter design easier.

Even though +5V is available from the CN6 connector, I decided to get operating power from the computer via the DTR line. I did this to minimize the number of wires needed from the radio. Since the DTR line from my computer sits at some negative voltage level when not active, I used a diode to prevent reverse polarity powering of the interface during these periods. A second diode is similarly used in the computer's TxD line to keep the logic "positive going."

My computer's RS-232 levels (I use a Compaq™ notebook for my radio applications) vary between ±10 volts, so I designed the interface around a +10 volt supply. To assure proper operation should I want to use the interface with some other computer with higher levels (RS-232 levels can be as high as 25V), I added a 10-volt zener diode. Since my computer is battery operated a lot of the time, its RS-232 levels often drop to 7V or so as the battery discharges, but this doesn't seem to affect the operation of the interface.

The level conversion technique used in this circuit is essentially a couple of open collector switched resistance voltage dividers as pull-ups for the radio and computer RxD lines, with a few extra components added to insure adequate protection for the radio. I used 2N2222 type transistors for my interface, but any similar device would work. Since the TS-50's data rate is fixed at 4800 baud, a device with good switching characteristics should be used for satisfactory operation at this moderately high rate.

I used the maximum value pull-up resistor value (15k) that would work reliably for the computer RxD line's circuit to minimize current drain. Since I added a 10k pull-down resistor to the radio's RxD line, I needed a circuit that wouldn't exceed the TTL limit of 5 volts in the event my added pull-down resistor failed, yet would still give a reasonable TTL high level with it in. As a precaution I added a zener diode to clamp this level to a maximum of 5.1 volts. My TS-50 seems to operate fine with RxD levels as low as 2.5 volts (remember my battery) with this interface, and the zener reassures me that I won't hurt my radio.

TxD from the radio is coupled to the switch transistor base using a 27k isolation resistor, and it is

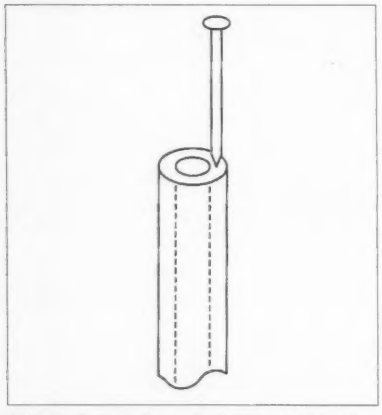

***Fig. 2.** Boring the end of a piece of hookup wire with a straight pin to allow connecting to CN6.*

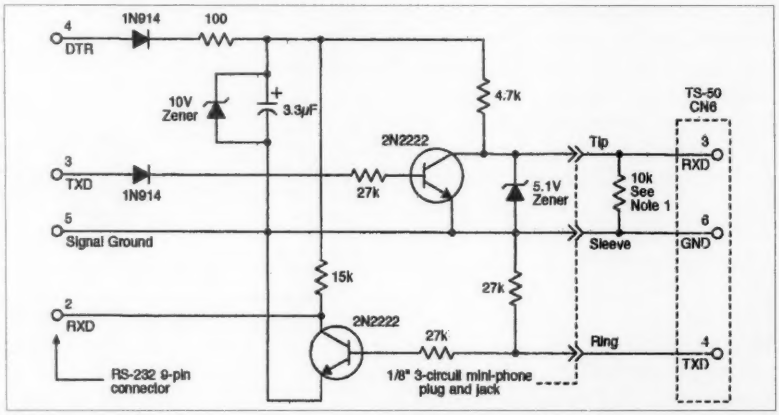


***Fig. 3.** The RS-232 level converter circuit and interconnect wiring details. Notes: 1) 10k resistor installed inside mini-phone jack cell. 2) All resistors 1/4 watt.*

loaded by a second 27k to signal ground. In a like fashion, the computer TxD is also coupled through another 27k resistor and a diode to prevent reverse bias of the switch transistor.

### Construction

The level converter interface circuit is built on a 1/2-inch by 1-1/4-inch piece of perf board to fit inside a 1/2-inch diameter piece of plastic tubing, as shown in **Photo C**. The component layout is not critical, other than placing them on the board in a low profile manner such that the whole assembly will fit inside the tube.

The tubing serves as an enclosure for the interface and as a strain relief for the cables. I secured the cables to the tubing with tie-wraps inserted through slits I cut into the tubing.

The circuit wiring is point-to-point, with jumper wires connecting the points as required. I used Teflon™ wire because it was available, but any good hookup wire will work. I attached the interconnecting cables by directly soldering the individual wires to their connect points at the perf board.

Because of the potential to emit RF noise, some special attention should be paid to RS-232 cables. I used shielded wire for both the computer cable and the cable to the radio. The computer cable is a four-conductor shielded type, and I connected the shield to one of the wires at the computer connector end only, letting the shield float at the interface board end. Similarly, the radio link cable has its shield connected to a wire at the plug end only. I did not use shielded wire inside the radio because the majority of it is run between the radio chassis and cabinet. Also, I used the ground connection at CN6 only, as a single-point ground at the radio to avoid any possible "ground-loop" problems.

### Preliminary checkout

I would suggest making a few continuity and resistance checks to verify your wiring before plugging the interface in. Once you're satisfied everything is wired correctly, preliminary tests can be made by connecting the interface cable assembly to your computer's COM port and bringing up a communications program. I used the terminal program bundled with Windows©,


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| LMR 400 DBL SHLD IIA JACKET 2.7 dB @ 450MHz | .53/ft | .51/ft |
| LMR 400 ULTRAFLEX DBL SHLD "TPE" JKT. 3.1dB @ 450 MHz | .79/ft | .75/ft |
| LMR 600 DBL SHLD IIA JACKET 1.72dB @ 450MHz | 1.25/ft | 1.22/ft |
| LDF4-50A 1/2" ANDREWS HELIAX 1.5 dB @ 450 MHz (25 ft.& up) | 2.10/ft | |
| FSJ-50 1/4" ANDREWS SUPERFLEX 2.23 dB @ 150MHz (25 ft. & up) | 1.50/ft | |

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| ITEM | 100ft/up | 500ft |
|---|---|---|
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| RG8/U FOAM 95% BRD UV RESISTANT JKT 1.2dB@ 50MHz | .32/ft | .30/ft |
| RG8MINI(X) 95% BRD BLK UV RES JKT (95TC, CLR, or WHT JKT TOO) | .15/ft | .13/ft |
| RG58/U SOLID CENTER COND 95% BRAID | .15/ft | .13/ft |
| RG58A/U SOLID CENTER COND 95% TC BRAID | .17/ft | .15/ft |
| 450 Ohm SOLID 18Ga. CW LADDER LINE | .12/ft | .10/ft |
| 450 Ohm STRD18Ga CW LADDER LINE | .15/ft | .17/ft |
| 24Ga. SOLID 4PAIR UNSHLD LAN CABLE "LEVEL II" PVC JKT | .16/ft | .14/ft |
| RG214/U DBL SILVER SHLD MIL-SPEC (25 Ft. & Up) | 1.75/ft | |
| RG142A/U DBL SILVER SHLD MIL-SPEC "TEFLON" (25 Ft & Up) | 1.25/ft | |

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| 14Ga. 7 STRD "HARD DRAWN" (permanent Dip.oles, etc.) | .09/ft | .07/ft |
| 14Ga.SOLID "COPPERWELD" (very long spans, etc. ) | .09/ft | .07/ft |
| 14Ga.SOLID "SOFT DRAWN" (ground radials, etc. ) | .09/ft | .07/ft |
| 3/16" DBL BRD "DACRON" ROPE 770# TEST, WEATHERPROOF | .12/ft | .09/ft |

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| 4060 6/Cond. (2/16 6/22) BLK UV RES JKT. Rec. up to 200 ft. | .35/ft | .34/ft |
| 1418 8/Cond. (2/14 6/18) BLK UV RES JKT. Rec. up to 300 ft. | .47/ft | .45/ft |
| 1218 8/Cond. (2/12 6/16) BLK UV RES JKT. Rec. up to 500 ft. | .76/ft | .74/ft |
| 18 Ga. Std 4/Cond. PVC JACKET | .20/ft | .18/ft |
| 18 Ga. Std 5/Cond. PVC JACKET | .23/ft | .20/ft |
| 18 Ga. Std 6/Cond. PVC JACKET | .29/ft | .21/ft |
| 18 Ga. Std 7/Cond. PVC JACKET | .25/ft | .23/ft |

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configured for 4800 baud, eight data bits, no parity, two stop bits, and software flow control.

With the communications program properly configured and the interface cable plugged into the computer, you should measure +3 to 5 volts between the radio plug sleeve and ring, and zero volts between the sleeve and tip. If you then short the tip to the ring, and hit a few keys on the keyboard, you should see these characters echoed on the computer screen, indicating the interface is functional.

Once the interface is verified as functional, you can connect it to the radio. I recommend connecting and disconnecting with power off at both the computer and radio, but I have hot-connected the interface with no harm. Once connected, and with the communications program configured as previously described, try typing "IF;" (use uppercase letters and don't use the quotation marks). The radio should reply with a string of data similar to that shown in **Table 1**. If this works, you have verified that the interface is working and capable of sending and receiving data to and from the radio.

### Control software

Kenwood Radios are perhaps the easiest to write control software for because command and data formats are in ASCII text format. This means you can use a standard terminal program, such as that bundled with Windows, to send commands and display data, although a custom program to enter and display data in a more user-friendly format is much nicer to use. The TS-50 uses a subset of commands that many Kenwood radios use, and I have included those I am aware of in **Table 1**. For those who wish to experiment in writing their own custom control program, I have included a QBasic listing of a program for entering and displaying frequencies in the sidebar, as an example of how easy such programs can be.

CIRCLE 304 ON READER SERVICE CARD


**Direct Frequency Entry & Display Program for the TS-50**

**TS-50TST.BAS**

Sample QBasic Frequency Write and Display Program for the Kenwood TS-50. (This program was tested on the TS-50 using a Compaq Aero Notebook Computer 11-30-95.)

```
OPEN "com1:4800,n,8,2,cd0,cs0,ds0,op0,rs,tb1024,rb1024" FOR RANDOM AS #1
SCREEN 1 'set up the big screen

PRINT #1, "FA;"; 'get initial frequency

WHILE w = 0 'start the main loop
 IF LOC(1) > 10 THEN
 CLS
 LINE (75, 70)-(250, 100), , B 'draw box around freq. display area
 ip$ = INPUT$(LOC(1), #1) 'transfer com buffer data to input string
 END IF

IF LEN(ip$) > 13 THEN 'update frequency display
 freq$ = ip$ 'make sure enough data gets transferred
 i = LEN(freq$)
 LOCATE 12, 15
 PRINT MID$(freq$, 6, 2); 'display megahertz
 PRINT ."."; 'put in the dot
 PRINT MID$(freq$, 8, 3); ","; MID$(freq$, 11, 3); 'kHz & Hz
 PRINT " MHz";
 ip$ = ""
 LOCATE 2, 2: PRINT "TS50 Frequency Control Program - K8KWD"
 LOCATE 24, 1: PRINT " f-key to Enter Frequency ";
 LOCATE 25, 1: PRINT " Q-key to Exit ";
 END IF

 b$ = INKEY$ 'scan for keyboard inputs
 IF b$ = "f" THEN 'we want to do a frequency write
 LOCATE 5, 10: PRINT " ": LOCATE 5, 10
 LINE INPUT "Enter Freq MHz.kHz "; c$
 d = INSTR(c$, ."") 'figure out where decimal point is
 IF d >= 1 THEN 'add a little trap for garbage keyboard entry
   'build the command string for frequency write
 m$ = LEFT$(c$, d - 1): k$ = MID$(c$, d + 1) 'split MHz & kHz
 IF LEN(m$) = 1 THEN hdr$ = "FA0000" ELSE hdr$ = "FA000"
 IF LEN(k$) = 0 THEN tl$ = "FA000000;"
 IF LEN(k$) = 1 THEN tl$ = "00000;"
 IF LEN(k$) = 2 THEN tl$ = "0000;"
 IF LEN(k$) = 3 THEN tl$ = "000;"
 IF LEN(k$) = 4 THEN tl$ = "00;"
 IF LEN(k$) = 5 THEN tl$ = "0;"
 IF LEN(k$) = 6 THEN tl$ = ";"

 LOCATE 6, 20: PRINT " ": LOCATE 6, 20
 PRINT #1, hdr$; m$; k$; tl$;
 hdr$ = "": m$ = "": k$ = "": tl$ = ""
 FOR i = 1 TO 4096: NEXT i 'add a little recovery delay
 END IF
 PRINT #1, "FA;"; 'update freq display
 END IF 'end of if freq write

 IF b$ = "Q" THEN w = 1 'that is all folks
 WEND

 {TS50DFI.DOC}
```

**Table 1. Miscellaneous TS-50 Commands and Data Formats**

| Command | Data Format |
|---|---|
| General Format | All commands are in upper case letters and are terminated with a semicolon (;). Many commands are dual function—they can be used to read and to write data. |
| FA; | Returns current VFO A Frequency as: FA00003976000; for example. The frequency data is in an eleven digit format with the left most digit representing the 10 GHz value, and the right, the 1 Hz value. This example translates to a frequency of 3.976 MHz. |
| FA{data}; | Writes a frequency to VFO A. Note that there are 11 data digits that must be filled (using zeroes as appropriate) for this command to work. It's possible with the TS-50 (and I suspect other Kenwoods) to write frequencies to 1 Hz resolution. |
| FB: and FB{data}; | Same as FA; and FA{data}; as described above except these commands read or write frequency to VFO B. |
| FN{Cmd Code}; | Function command, sets VFO A/B or Memory:<br>FNØ; = VFO A<br>FN1; = VFO B<br>FN2; = Memory Mode |
| ID; | Returns Radio Identification Number:<br>IDØ13; (for the TS-50) |
| MD{Cmd Code}; | Mode Command, sets Communications Mode:<br>MD1; = LSB<br>MD2; = USB<br>MD3; = CW<br>MD4; = FM<br>MD5; = AM<br>MD6; = FSK |
| RX; | Commands Radio to receive (see TX command). |
| SP{Cmd Code}; | Sets Split Mode on or off:<br>SPØ; = OFF<br>SP1; = ON |
| TX; | Switches Radio to transmit. Once sent, the radio remains in transit until the RX; command is sent (or power off). |
| IF; | Returns current status in a 35 character string such as:<br>`IF00001850000  -015000 0701000  ;`<br>where the first eleven characters represent frequency in the same format as 'FA' above. Characters 12 thru 16 are not used. Characters 18 thru 21 represent RIT frequency in Hz, with the 17th giving the direction as plus (+) or minus (-). Characters 22 and 23 indicate RIT/XIT status respectively; a zero = off, a one = on. Character 24 is not used. Characters 25 and 26 indicate Memory Channel number. Character 27 indicates whether the rig is in receive or transmit; zero = receive, one = transmit. Character 28 indicates current mode (see mode command above). Character 29 indicates function similar to function command described above. Character 30 indicates whether scan is on or off; zero = off; one = on. Character 31 indicates if split mode is on or off; again, zero = off, one = on. Characters 32 thru 35 are undefined. |

73


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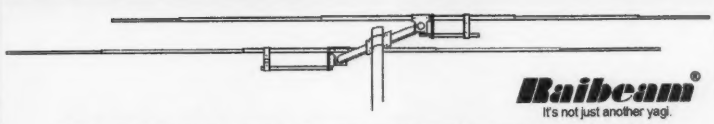

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# Worthy of Recognition: Hap Holly KC9RP

*Blindness is a challenge for this versatile, accomplished ham.*

Dave Miller NZ9E
7462 Lawler Ave.
Niles IL 60714-3108

In the March 1996 issue of *73*, Wayne Green asked readers to consider generating some articles on fellow hams who they felt deserved acknowledgment before they became Silent Keys and were recorded only in memory. It's easy to recount an individual's achievements after he or she is gone, but if someone is doing something worthwhile, don't those deeds deserve recognition while the person is still around? I think so, too.

When Uncle Wayne wrote about it in his editorial, I immediately thought of a friend of mine, someone who's overcome a great obstacle to become recognized as doing something worthwhile each and every week for the amateur radio community; Hap Holly KC9RP, founder, guiding light, and moderator of the weekly amateur radio audio feature magazine known as RAIN—the Radio Amateur Information Network.

## RAIN

From his home studio/ham shack in suburban Chicago, Hap produces his 12 to 17 minute weekly amateur radio program service, featuring timely interviews, thought-provoking commentaries from other hams (yours truly included), excerpts from Dayton Hamvention Forums, and other items of general interest to the amateur community at large. Ham radio is traditionally an aural—as opposed to a visual—medium; we meet and recognize fellow hams primarily by voice, seldom seeing them in person. RAIN programming is also an aural medium, distributed to hundreds of repeaters across the country via the RAIN dial-up line, commercial satellite, Hap's subscription service on audio tape, and WAØRCR's weekly 160 meter informational broadcasts. Those repeater groups, and others, then replay the weekly RAIN tapes over their local repeater systems on their regular "net night" gatherings, permitting thousands of hams to hear Hap's offerings for that particular week. It's all done with volunteer help and, in the best of amateur traditions, without profit to anyone involved.

***Photo A.** Hap Holly KC9RP where he feels most comfortable—at the controls of the audio board, where he puts together his weekly RAIN amateur radio audio magazine show, and*

Hap Holly makes it happen; he's an uncommonly intelligent and outgoing individual. Hap is also very aurally oriented and insists on quality in every way in his RAIN programming. He conducts most of the interviews, edits and engineers all of the program material, writes the scripts, duplicates and mails out the RAIN cassettes, and archives and catalogs the RAIN library. It's all accomplished by touch and by ear. Hap is one of a number of non-sighted amateurs within our ranks, but you'd never know it.

## Hap's history

For Hap, blindness came literally overnight when he was only seven

years old. Problems with his vision began when he was four, but then he awoke one morning totally blind. The condition is untreatable, at least within current medical terms, but to Hap, it hasn't been a handicap. In fact, in talking to him over the years, most of his friends tend to forget his unusual challenges because he does so much of what we all do, without mention of his visual impairment.

Both of Hap's parents were blind. His father's vision loss resulted from a football accident in college, but Hap's dad still became a successful building contractor and architect, formulating the plans he devised within his "mind's eye," then describing the details precisely to his secretary, who constructed balsa wood models. Then, only by touch, he would go over the "three-dimensional plans," incorporating additions or changes as needed. Hap's father was also a longtime columnist for the *Christian Science Monitor* and was known worldwide for his "Ask a Builder" column, which he wrote from 1965 until his passing in 1984. He was a touch-typist—as is Hap—and was able to generate his column by that method alone (before the days of computers, word processors and voice synthesizers).

Hap's mother lost her sight when she was around twelve years old. A 1988 book about her life, titled *What Love Sees*, depicted her struggle for independence from her New England industrialist father, her marriage to Hap's dad, and the eventual challenges that two sightless parents encountered raising four sighted children—then Hap, too, became blind. The book is being made into a made-for-TV movie this year, which will be shown on the CBS television network when completed. It will star Richard Thomas of the original "Waltons" series, and Annabeth Gish, who played Pat Nixon in the widely acclaimed motion picture "Nixon." The TV movie, which is also called "What Love Sees," primarily takes place in the small Southern California ranching town of Ramona (where much of it was filmed), and reportedly follows the Holly household up until shortly


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after the time that Hap's sight was lost and the family was forced to move to a larger city—Escondido—to seek specialized educational opportunities for their youngest son. Hap was able to spend a few hours with the movie company as they were shooting the film, meeting with and talking to the actors, including the eight-year-old boy who portrays the "young" Hap Holly. Be sure to watch for "What Love Sees" this October on CBS. The original book, from which the movie's script was developed, is scheduled for reprinting this summer, in large print form from Thorndike Press, for readers with visual handicaps. Also in the works is a proposal for a "talking book" version of the original book to coincide with the publication of the large print edition.

Hap's ham career began when he earned his Novice ticket in 1965, at the age of 14, receiving the callsign WN6UJH, while living in Escondido. He became a General—dropping the "N" in his call—a year later, in 1966, and served as a phone-patch station and net control for the Westcars traffic net until 1970. Hap then headed off to Principia College in Elsah, Illinois. From 1970 until his graduation in 1974, he ran phone patches and kept radio schedules for his fellow students. He graduated with a Bachelor of Arts degree in sociology, and soon found himself in the Chicago area, where he sought out world-class jazz accordionist Leon Sash, to pursue his other love, music. A year later, another love, Stephanie, became the center of Hap's attention and the two were married in August of 1976. They had met the previous summer at the Roundup Ranch in Buena Vista, Colorado, where Hap was a counselor. He taught a class in non-visual perception to the high school campers at the ranch, all of whom were sighted, but who learned to "see" in yet another way, with Hap's patient guidance. Hap's wife, Stephanie—who is sighted—received her ham ticket and the call KA9WKD in 1986 after realizing how much ham radio, and the good it was able to accomplish, meant to Hap.

In 1977, Hap picked up the "9-land" call of WD9GJQ when he and Stephanie moved into their comfortable home in Des Plaines, Illinois, where he resumed his phone-patching and DXing activities with his now permanent antenna and station setup. In 1981, Hap passed his Advanced Class license exam and changed calls once more, this time to his current KC9RP callsign.

I met Hap when he served as ham radio informational programming guru for the BEAR, the Broadcast Employees Amateur Repeater in suburban Chicago, from 1984 to 1989. Hap's weekly "net nights" became something of a legend in the Chicago area, sometimes attracting in excess of 100 check-ins, via simulcasts on five area repeaters. This stint led to Hap's forming RAIN and the weekly RAIN Dial-up, the RAIN Monthly audio tape and the bimonthly RAIN Journal tape (produced especially for blind amateurs). According to Hap, "My inspiration for producing weekly ham radio programming resulted from my need to know. I faithfully listened to the weekly Newsline (formerly WestLink Radio) reports in the early 1980s on my local repeater. I owe a great deal of gratitude to Newsline's founder and producer, Bill Pasternak WA6ITF, for his encouragement and direction. RAIN is truly an offspring of Newsline, but with a human interest focus, as opposed to a news-only approach."

As mentioned before, Hap's RAIN programming can now be heard on hundreds of ham repeaters across the nation, or by calling 847-827-RAIN*. Vern Jackson WAØRCR also carries the RAIN Dial-up on his 160 meter Gateway Radio Newsletter AM bulletin service from Wentzville, Missouri, on 1.860 MHz several times each week.

In recent years, Hap has written for *Spec-Com Journal, Radio Scan Magazine,* and, occasionally, reports for Newsline. He's a common sight at the yearly Dayton Hamvention, taping a number of the forums with the help and cooperation of the Hamvention organizers. Excerpts of these forums are then incorporated throughout the year in Hap's RAIN programming, making Dayton come alive for those of us who may not have been able to attend personally.

Hap is also active on HF, VHF, amateur radio packet, and now the Internet, using his Versa-Braille II Plus terminal. The Versa-Braille allows an accomplished Braille reader like Hap to "read" the packet bulletins and to access his Internet E-mail with nearly the speed of a sighted user. He's also working with his 386 computer and a standard keyboard, in conjunction with a speech-output device.

As a professional keyboardist, Hap's diverse repertoire of music from the last 60 years has made him a popular choice for Chicago area musical engagements. He's also an active and honored member of the Des Plaines Lions Club and received their prestigious international Melvin Jones Fellowship plaque for his service to humanity. As a member of the Des Plaines Toastmasters, Hap has served as its president several times, and has twice served as an area governor.

For Hap Holly, blindness has never been a disability, only a challenge that has served to "fine-tune" his other senses. If you have a friend or relative with a serious handicap or disability, and you've felt that amateur radio would be a worthwhile hobby for them to pursue, perhaps Hap's extraordinary story might be just the inspiration they would need to take the plunge. Hap would disagree with my choice of terms (extraordinary) since he considers his accomplishments no more than the expected effort required to achieve anything worthwhile—but then that's the signature of extraordinary people, isn't it? 73

Hap's RAIN Dialup can be accessed by calling 1-847-827-RAIN (7246). Hap's Internet E-mail address is hholly@ais.net. His amateur packet address is KC9RP W9ZMR.EN52VA. IL.USA.NOAM. RAIN's mailing address is RAIN, P.O. Box 2565, Des Plaines IL 60017-2565. Hap can receive voice-mail at 1-847-518-6551

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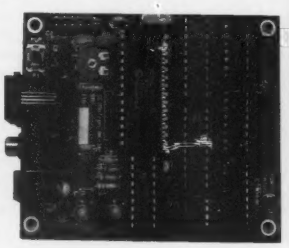

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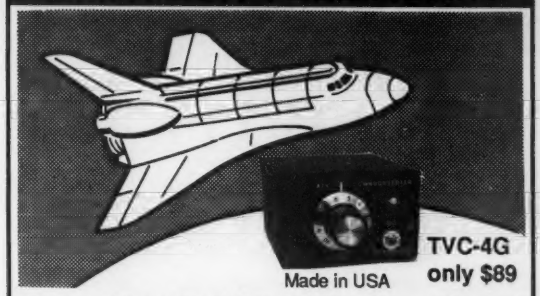

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## NEVER SAY DIE

*Continued from page 4*

not many attendees ventured. Several hams with "Staff" hats on came by my booth, but none said anything about it being nice that we were there. None offered any help. There was no area set aside for exhibitors to rest or get a cup of coffee. We all had to either queue up to the single commercial food supplier and buy our lunch or go hungry. I looked at the long line a few times and went hungry. Not that the menu or the high prices were attractive.

I did enjoy talking with old friends and we sold a handful of subscriptions.

Dayton is successful because they have an experienced team running it. The Atlanta HamFestival did not pursue me to talk far enough ahead for me to alert the *73* readers who enjoy my talks and get them to come. That can usually bring in a few hundred loyal fans.

Some of the hams I talked with had also attended Dayton a few weeks earlier. Now, if Dayton can bring 'em in from Georgia, obviously a well-run and promoted show in Atlanta should be able to haul 'em in from Dayton. And should be attracting ham caravans from Missouri, Arkansas, Louisiana, and so on.

These days, with the hobby in a near zero-growth mode except for Techs, hamfests need showmanship to attract attendees. Hamfests are in serious need of some new ideas and sizzle.

**Adventure Anyone?**

Are you getting your share of adventure out of amateur radio?

The greatest adventures of my life have come from ham radio, so in my radio interviews and hamfest talks I point out the adventures the hobby makes possible. Whether you take advantage of the opportunities for adventure or not is up to you. They're there, if you watch for them, and your ham ticket is the key to open the door to adventure.

My ticket got me into the Navy during WWII as an electronic technician. I was originally slated to work in a research lab in Anacostia, Virginia, right across from Washington, DC. Instead, I volunteered for duty on a submarine and as a result had a couple of lifetimes-worth of adventure. I've written about all that in my $8 book on the subject. We had quite a few ver-r-ry tense moments. It sure was exciting at times.

Hey, how come you've never gone on a DXpedition? Ask anybody who's gone on one and they'll tell you that you'll remember every minute of it for the rest of your life. My first DXpedition was to Navassa (KC4AF), a tiny island down between Jamaica and Haiti. Wow, what a fantastic trip that was! Yes, we came tha-a-t close to being killed a couple times...but we weren't.

Then there was the time I heard about an around-the-world flight with a 20m ham station aboard that needed an extra operator. Operation World Wide, it was called. That's right, an all-expenses paid trip around the world, working 20m all the way around! Yes, of course I volunteered.

Or how about the time Robbie 5Z4ERR on 20m talked me into visiting Nairobi? Well, I'd just read a book by Herter on how to go on an African Safari for $690, so I asked for some company in my editorial and got two hams to go along. And since it only cost a little more to keep on going around the world, we went hunting and then got to places like Baghdad, Khartoum, Katmandu, Damascus, Rangoon, and so on, operating wherever possible. Like from the now famous American Embassy in Tehran. And Afghanistan. Talk about adventure!

How about when the State Department selected me to

*Continued on page 40*

# A $60 Red Hot Receiver Kit!

*The Ten-Tec 1253—another winner. Fire up your soldering iron!*

Mike Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

It's just about as old as radio itself. I'm talking about the regenerative receiver, which was invented by Major Armstrong. This is the receiver that got the radio hobby we have today started. Along with the "super-regenerative" receiver and then the "superhet," radio has changed very little from the rig Armstrong invented so many years ago. I've never had the time to sit down and build a tube type regenerative receiver, but I've read countless articles on their construction. So, when I spied a regenerative receiver kit made by Ten-Tec, I knew I had to have one.

The Ten-Tec 1253 is a nine-band regenerative receiver with more features than most direct conversion (and superhet) rigs many QRPers build. And there's more. For, you see, Ten-Tec also designed this kit around a really slick-looking box. It's much more radio than you might think, with a selling price of $60. You get a lot of controls to play with. There's RF gain, regeneration, main tuning, fine-tuning and the volume control (see **Photo A**).

***"The result is a good looking, good sounding radio for a darned good price."***

You can select any of nine popular shortwave bands by the use of pin diodes. The regulated power supply and the varactor tuning produce a smooth tuning action. The use of a "bandspread" fine-tuning control makes picking out CW signals a snap! Best of all, there's not a single coil to wind! So, with that in mind, let's look a bit closer inside the Ten-Tec 1253 shortwave receiver.

***Photo A.*** *You get a lot of controls to play with. There's RF gain, regeneration, main tuning, fine tuning and the volume control.*

**Inside the kit**

There are two PC boards. One contains the audio, regeneration components and the required L/C networks for the various bands. The second board contains the band switching electronics. This small board is double-sided with plated-through holes. The main PC board is single-sided and not plated. However, there is a coating on the main PC board that acts as a solder mask. Although this coating covers every pad on the board, you can solder through it with no problems (see **Photo B**).

All the pieces parts are included for both PC boards. Ten-Tec gives you all the nuts, washers, and board-mounted components.

Assembly is straight forward. The manual starts out with several questions and answers about following the manual or jumping right into the pile of parts. I decided to follow the manual, beginning the assembly by stuffing the main PC board with the audio components. After soldering and cutting off the wire leads I had the option of testing out this part of the receiver before proceeding. I recommend you follow Ten-Tec's testing steps. After all, if the audio section doesn't work, adding more parts to the circuit board will not fix the problem in the audio stage.

I tested the audio and found it working as it should. I also noticed, as the assembly instructions continued, a note about wrapping the loose wires (used in the audio test procedure) around the volume control to prevent their breaking off. That's a nice touch.

The next step was to follow the step-by-step instructions for assembling the RF amplifier, the regenerative detector, and varactor tuning.

Again, they suggest you test the receiver to make sure the regenerative detector is working, before going to the next step, which is to decide how you want the regenerative detector to work. Adding an extra coil and capacitor to the detector controls changes how the regenerative detector behaves. Adding the extra parts increases the sensitivity to weak signals, but requires a careful hand in controlling the regeneration control. Ten-Tec recommends that newcomers to regenerative receivers *not* install the two extra parts.

The next testing step has you adding the necessary parts for one band. The band selected is 6.8 to 8.5 MHz. There's always something on these frequencies, no matter what time of day or night.

I noticed two things when I applied power to the radio. First, the damn thing worked! Second, the radio sounded *really* good! There's plenty of audio from this little guy, thanks in part to the hybrid audio amplifier. With the radio operating, I tackled the band switching board, which was a bit tricky to assemble. Parts are placed on *both* sides of the board, so it's easy to get confused as to what goes where. Ten-Tec makes the assembly as painless as possible with an oversized PC board layout and a table showing you on which side each part goes.

The hardest part is aligning the nine small LEDs with the holes in the front panel, and then soldering them in place.

The mounting holes on the front panel are designed to allow some slop in your assembly of the LEDs.

After you have checked out the band switching board, you finish by stuffing the balance of the band specific components on the main PC board. This requires close attention. If you get one of the inductors or one of the wires from the band switch out of place, then the selected band may not match the LED.

The only steps left were connecting the remaining wires to the two circuit boards and installing the hardware. The receiver is assembled on a sub-chassis and then the sub-chassis is mounted inside the main box. There are two plastic battery holders to hold the eight C cells for portable use which mount above and to the rear of the sub-chassis, using a second sub-chassis.

All in all, Ten-Tec did a marvelous job of designing the 1253 kit. But naturally, like any ham, I have a suggestion: How about putting the main PC board overlay on a separate sheet of paper along with the schematic of the 1253? That would make it easier to troubleshoot without having to flip back and forth between the pages of the manual.

### The manual

Aside from the single overlay sheet, a complaint I have with nearly all kits, the manual is complete and easy to understand. Ten-Tec has included points of soldering, installing parts on the PC board and detailed operating instructions. There's even a section on installing an antenna and how to tune in SSB and CW.

### On the air with the Ten-Tec 1253

The 1253 takes some getting used to. When you advance the regeneration control to just below the point of oscillation, this is the best place for AM detection. Then you advance the regeneration control a hair to where the detector breaks into oscillation for CW and SSB reception. By selecting the point of regeneration, you have control of how sensitive the detector is.

It's amazing how sensitive the 1253 is! I was able to pull in AM shortwave stations from all over the world with just a 10-foot length of wire lying on the floor.

The ability to operate from the internal batteries makes the 1253 an ideal travel companion. And there's plenty of room inside to install a simple RF preamplifier. Drill a hole in the top for a telescopic antenna and you'll have a fine rig for camping. A rear-mounted headphone jack automatically disconnects the internal speaker.

In use you'll find that with a regenerative receiver strong signals have a tendency to swamp the detector, causing it to lock up on the signal. And increasing the RF gain causes it to change frequency. Although the 1253 has a stage of RF amplification, regenerative receivers do produce a signal (the output of the detector) that can radiate quite some distance.

All in all, I had a ball with this guy. It's easy to build and easy to fix. The end result is a good looking, good sounding radio for a darned good price. I highly recommend the Ten-Tec 1253 shortwave receiver kit. Interested? Call Ten-Tec's information line at (423) 453-7172, or write them at 1185 Dolly Parton Parkway, Sevierville TN 37862-3710.

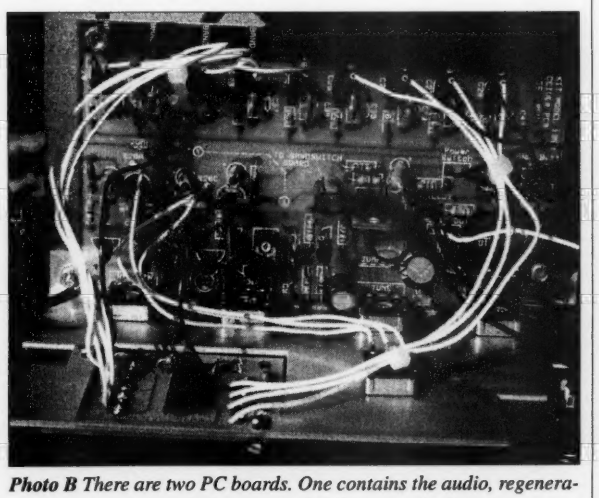
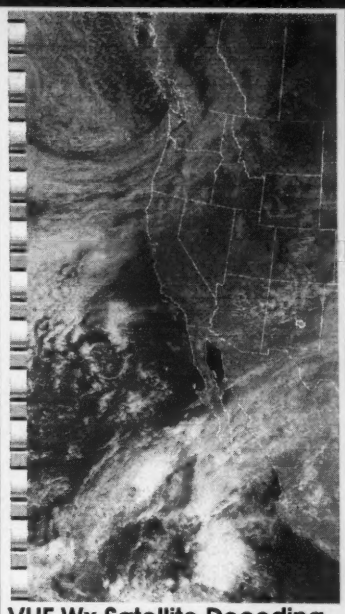


***Photo B** There are two PC boards. One contains the audio, regeneration components and the required L/C networks for the various bands. The second PC board contains the band switching electronics.*


Get The Picture!



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# Simple Crystal Activity Tester

*Check and match crystals for your home-brew projects.*

J. Frank Brumbaugh KB4ZGC
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Salinas PR 00751-0030

Quartz crystals are found in practically every piece of electronics used by today's amateurs. Hams who build their own equipment find themselves using crystals in many projects.

Many low power transmitters and double conversion receivers require crystals for their stable oscillators. Crystal ladder filters used in receiver IF circuits must have crystals closely matched in frequency to ensure steep skirts.

Crystals are available from a variety of sources. Most hams, especially older hams, usually have spare crystals in their junk boxes. These are often available for very low prices at hamfest flea markets. Most such crystals are in the lower ham bands, while some are multiplier types for higher frequency bands.

Most mail order parts dealers advertise long lists of inexpensive surplus microprocessor crystals, ideal for ladder filters in receiver IF strips. Many, too, are suitable for use in home-brew test equipment such as capacity and inductance measuring instruments.

Regardless of its intended use, a crystal must be active. That is, it must start oscillating immediately when power is applied. It must oscillate on a single frequency, and that frequency must be stable. The more active a crystal is, the better it will perform, whether as an oscillator or in a filter.

In addition to being of good quality, the several crystals used in receiver IF filters must all be matched to the same frequency within tight tolerances. Purchasing a set of four, six, or more frequency-matched crystals from a manufacturer is extremely expensive. Buying a handful of surplus microprocessor crystals for about a dollar each and matching them yourself will cost only a fraction of the price of a commercial set.

The simple instrument described here enables easy checking of crystal activity. Used with a frequency counter, crystals can readily be matched in frequency to within a few hertz. It covers the important range of below 1 MHz to slightly above 13 MHz. The crystals used by hams in oscillators and filters fall within this range of frequencies.

Two versions of this instrument are illustrated: a simple and a deluxe. The only difference is in the method of indicating crystal activity. In the simple version, the brightness of an LED indicates activity level; in the deluxe version, a meter indicates activity level. In its simple version this instrument can be constructed in under one hour for less than five dollars, and probably at no cost at all when using junk box parts. The deluxe version will cost little more.

### Circuit description

**Fig. 1** shows the schematic version for the simple version; **Fig. 2** illustrates the changes required for the deluxe version. Please refer to this illustration for the following discussion.

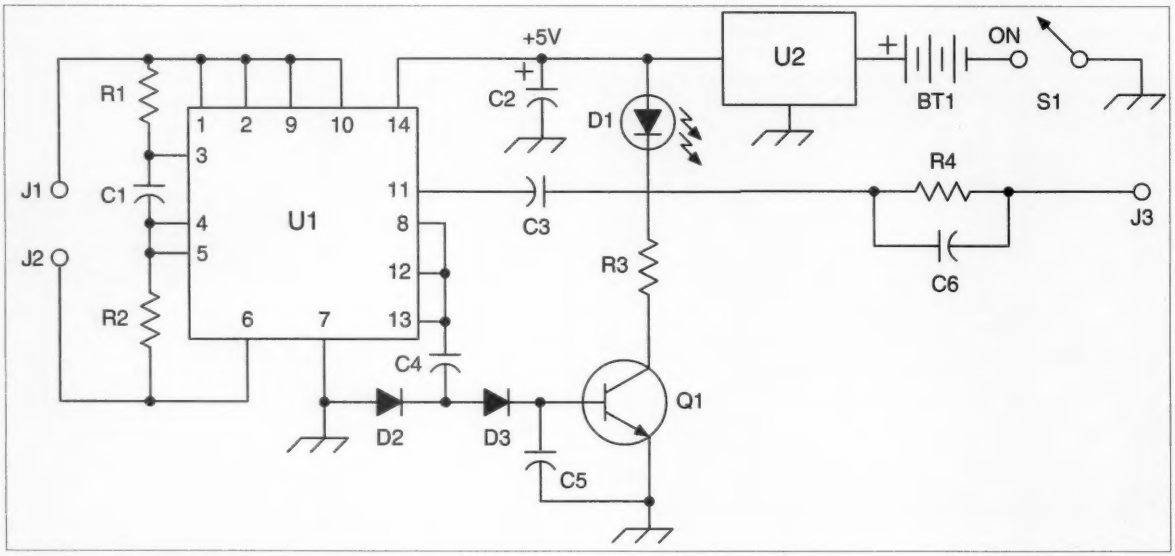


*Fig. 1. Crystal matching and activity tester; simple version.*

Power is supplied by a 9 volt alkaline battery (BT1) and is controlled by ON/OFF switch S1. Nine volts is applied to the input of U2, a 78L05 three-terminal regulator which produces a regulated +5 VDC for the circuit. The positive bus is bypassed by C2, a 10 µF electrolytic capacitor.

U2 is a 74LS00 Quad two-input NAND gate logic chip. The LS version was selected because of its low current requirement. Two of its internal gates are connected as inverters and, in conjunction with R1, R2, and C1, form a crystal oscillator when a crystal is connected between J1 and J2.

The third gate, also connected as an inverter, is used as a buffer to provide RF at the crystal frequency from pin 11, through isolation capacitor C3 and high-pass filter R4 and C6, to J3 so the crystal frequency can be monitored by an external frequency counter.

The fourth gate, also connected as an inverter-buffer, provides RF at the crystal frequency from pins 8, 12, and 13 connected in parallel. The RF is fed through isolation capacitor C4 to voltage doubling rectifiers D2 and D3, and the resulting DC voltage is filtered by C5 and, in the simple version, provides a positive bias to the base of Q1, an NPN transistor, which is normally cut off. Q1 goes into conduction and its collector current flows through LED diode D1 and R3 in series, both forming the collector load circuit. The greater the activity of the crystal, the higher the positive bias on the base of Q1 will be, and the higher its collector current will be. This current illuminates D1 and its relative brightness is indicative of the level of crystal activity.

In the deluxe version, the filtered DC voltage across C5 is applied to the positive terminal of M1, a 0-1 mA meter, whose negative terminal is connected to the wiper of R5 (a *sensitivity* potentiometer), one end of which is grounded. R5 is used to keep the needle of M1 on scale, and M1 indicates crystal activity level. Using this version makes it easy to match crystals of the same activity, or to select the one having the highest activity. The meter won't give an absolute value reading, but it can be effectively used for relative comparisons between crystals.

## Construction

This tester can be constructed on a small piece of perf board, or on one of the small general purpose printed circuit boards available at Radio Shack™. It can also be built "dead-bug" style by gluing U1 and U2 upside down on a piece of wood or plastic. No enclosure is absolutely required, but if you expect to use this instrument a number of times it should be enclosed in an aluminum or plastic box, or in a case made of printed circuit board material. This is especially desirable if the deluxe version is constructed because the enclosure will provide a secure mounting for the meter.

J1 and J2 are specified as binding posts because most surplus microprocessor crystals are available in HC-18U or HC-33U cases with wire leads. Most other crystal case styles require sockets. Crystal sockets can be wired in parallel with J1 and J2 for greater convenience in testing various types of crystals.

The leads between U1 and J1/J2, plus any parallel connected crystal sockets, should be kept as short as possible.

The circuit between pin 11 of U1 and J3 should also be as direct as possible and its wiring kept away from the walls of the enclosure, if one is used.

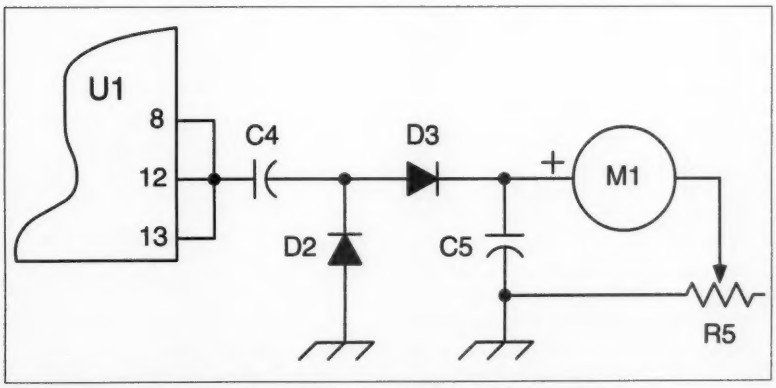


***Fig. 2.** Crystal matching and activity tester; changes for the deluxe version.*


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C4, C5, D2 and D3 should be physically close to U1. All other wiring carries only DC voltages and can be any reasonable length.

### Operation

Operation is automatic. Set S1 to ON and connect a crystal with a frequency between 1 and 13 MHz between J1 and J2 or in a parallel socket. Observe the relative brightness of D1 in the simple version, or the indication on meter M1 in the deluxe version. Use the sensitivity control R5 to keep the M1 needle on the meter scale.

To measure the series resonant frequency of the crystal under test, connect the input of a frequency counter between J3 and ground and observe the frequency on the counter's readout.

### Comments

This instrument is designed to function with crystals whose fundamental frequencies lie between 1 and 13 MHz. Some crystals slightly outside this range may oscillate, but this cannot be guaranteed.

A crystal which shows no, or very low, activity is either bad, suspect, or outside the range of this tester. Even if a crystal is marked with only a house number, instead of its frequency, it should be tested. It may very well be a useful crystal for you.

A sluggish crystal, one whose output level varies or which will not oscillate every time it is connected to this instrument, should be discarded unless it is in an FT-243 crystal holder. This special case will be discussed later.

Most crystals manufactured recently are sealed in metal cans. Normally these crystals are quite active and stable, although all crystals age, causing them to oscillate at a slightly different frequency than when first manufactured. If a crystal (within the range of this tester) in a sealed metal can refuses to oscillate, discard it. Perhaps the quartz blank is contaminated, or cracked, or one of the fine wires soldered to the metallized surface of the crystal has been detached. Rough handling, including simply dropping them on a hard surface, can destroy these crystals.

### Restoring FT-243 crystals

Crystals in FT-243 holders, most of which are WWII surplus, often are available very cheaply at hamfest flea markets. Most are in the lower ham bands, or have frequencies suitable for multiplication to higher bands. Many of these crystals may either refuse to oscillate at all, or may be sluggish or have low activity, but many are easily salvaged unless there is internal mechanical damage.

You will need a brightly lighted work space, a clean, soft cloth to cover it, a pair of tweezers, a small Phillips-head screwdriver size 00 or 000, some alcohol (rubbing alcohol and vodka are suitable), and cotton swabs.

Spread the clean cloth over your work space. Using the small screwdriver, carefully remove the three tiny screws holding the metal faceplate to the plastic crystal holder.

*Caution: Hold the metal faceplate firmly to the case while removing the screws. Do not allow the internal spring to toss the faceplate and crystal blank across the room!*

Gently dislodge the faceplate and the rubber gasket behind it, and remove the spring. Set them aside for now.

The quartz blank, about half an inch square, rests between two very delicate thin brass plates. One lower corner of each brass plate is soldered to the holder pins. Gently shake the quartz blank from the holder onto your cloth work surface and set the holder aside.

*Caution: Use extreme care not to break the connections between the brass plates and the pins. It is impossible to repair the holder in this case.*

Very carefully, using a swab or the corner of a clean, soft cloth dipped in alcohol, clean the insides of both thin brass plates in the holder. Gently blow out or scrape out any loose dirt inside the holder. Set the holder aside to air dry.

Clean the crystal blank with alcohol as just described, using tweezers to hold it and move it around. ***Never*** touch the quartz blank with your fingers, and try not to breathe on it. When it is clean, set the blank aside to air dry.

Now clean the outside of the crystal holder, rubber gasket, and metal faceplate with alcohol, and set aside to air dry. Fold the clean cloth over all the pieces to keep them dust free. Be sure to allow plenty of time for the alcohol to evaporate.

When all is ready, pick up the crystal blank with tweezers and insert it into the holder between the two brass plates. Gently replace the spring on the outer brass plate, centering it. Then replace the metal faceplate and rubber gasket, gently forcing them against the spring until the three screw holes in the faceplate line up with matching holes in the plastic holder. Replace the three tiny screws, snugging them up firmly. Do not use so much pressure that you strip the threads in the plastic holder.

Clean off the outer surface and pins of the holder, then connect it between J1 and J2 or insert it in its socket. Turn the tester on and check for crystal activity and frequency. Chances are you will have salvaged a tired crystal and given it new life. 73

**Parts List**

| | |
|---|---|
| BT1 | 9V alkaline battery |
| C1, C3, C4, C5 | 0.01 µF ceramic disc |
| C2 | 10 µF 16V electrolytic |
| C6 | 27pF ceramic disc |
| D1* | LED |
| D2, D3 | Silicon diode: 1N914, 1N4148, etc. |
| J1, J2, J3 | Binding post (see text) |
| Q1* | NPN 2N3904, 2N2222, etc. |
| R1, R2 | 560 ohm 1/4W 5% |
| R3* | 300 ohm 1/4W 5% |
| R4 | 1.2 megohm 1/4W 5% |
| R5** | Øk ohm potentiometer |
| S1 | SPST toggle or slide switch |
| M1** | Ø-1 mA meter |
| U1 | 74LSØØ |
| U2 | 78LØ5 |

*Used on simple version only.
**Used on deluxe version only.

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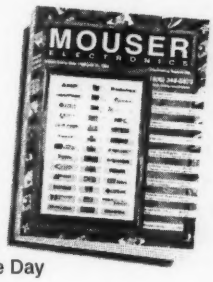


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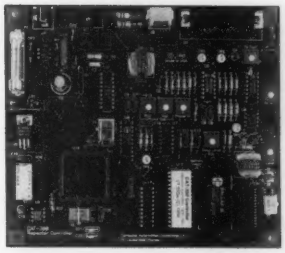

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CIRCLE 268 ON READER SERVICE CARD

## About Surplus Crystals

Crystals can be, and are, ground to various tolerances, expressed in ppm (parts per million; hertz per megahertz). Close tolerance crystals can be very expensive. Most crystals on the surplus market have relatively wide tolerances. Microprocessor crystals, such as those sold surplus by many mail order parts dealers, are usually ground to a tolerance of ± 500 ppm—a half kilohertz per megahertz. A crystal marked "10.000000" can actually be anywhere between 9.995 and 10.005 MHz. The chances are very good that surplus crystals are mostly those whose frequencies fall outside even that wide tolerance. However, when used in transmitters, local oscillators, product detectors and BFOs, it is relatively simple to adjust the crystal to the exact frequency required. Most oscillator circuits contain trimmer capacitors that allow the exact oscillator frequency to be varied a small amount on either side of the crystal's resonant frequency. This process—called rubbering, warping, or trimming—allows precise adjustment of off-frequency crystals.

Crystals intended for use in an IF crystal ladder filter must be matched closely to each other in frequency to maintain steep skirts, although the exact frequency is relatively unimportant. So an 8 MHz crystal filter *might* have all 8.000000 MHz crystals in it, but it is far more likely that all crystals are somewhat below or above 8 MHz. But this filter still functions exactly as it was intended.

Microprocessor crystals, although marked with their *nominal* frequency to six decimal places, are manufactured specifically for use in either their series or parallel mode of oscillation. It is impossible to know which when you buy such a crystal. It also makes absolutely no difference because you are going to use it in an entirely different circuit than that for which it was ground.

There is always a slight difference in oscillation frequencies between a crystal operating in its series mode and the same crystal oscillating in its parallel mode. Regardless of the manufacturer's intent, you can use the crystal in either type of circuit, or in a filter.

Depending upon the circumstances, some circuits used by hams force the crystal to oscillate in its series mode, while other circuits force parallel mode oscillation. This instrument allows crystals to oscillate only in their series mode, at the fundamental frequency to which the quartz blank was ground. It is far simpler and cheaper to build an instrument to check crystal activity and frequency in the series, rather than in the parallel mode. Crystals used in the series mode, such as in IF filters and certain types of crystal oscillators, will be resonant at the exact frequencies measured by this instrument. When a crystal is used in a circuit where it oscillates in its parallel mode, it will produce a very slightly different frequency than that measured in its series mode. Usually, this will make no difference. Where it may be important, the crystal frequency can be easily trimmed to an exact frequency. 73

# PVC Goes Camping

*Full-time RVers, take note!*

James Bassett KA1FPP/7
7420 Silver Leaf Way
Las Vegas NV 89117

Now that summer has arrived, it's time to get out the camping equipment. My list starts with: QRP rig, CW key, mike, coax, some wire, slinky...Did he say slinky? Did he mean the Slinky™ kids play with?

Yep, sure did. Seems the Slinky vertical fits into the camping box better than the 25-foot trap vertical or the poles needed to hold up a dipole. The Slinky is cost-effective; last time I bought one it was under $2.

**Why a Slinky?**

I camp quite often at the Lake Mead National Recreation Area. The total number of trees is zero, meaning that any antenna must be self-supporting. The soil in the area varies from soft silt to hard as cement, making it necessary to devise a method that will not require that the ground conductivity be a factor. The structure supporting the Slinky must be flexible, lightweight, strong, and easy for one person to manage. With these requirements in mind, I designed the Slinky Vertical. A standard Slinky serves as the main radiating element, and common PVC tubing provides the support structure. The resulting antenna is quickly assembled, easily moved, and can be stored in a very small space.

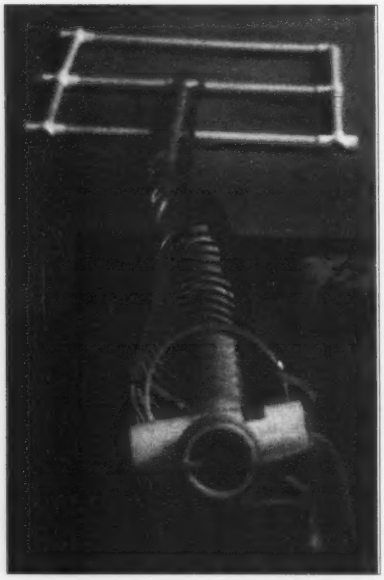


***Photo A.** The top guy ropes are tied to the upper PVC cross before the antenna is erected.*

**Construction**

The PVC is cut into sections that fit into the bottom of my camping gear box. This makes it easy to store and carry. Other PVC pieces required include: double females, tees, and crosses. Precutting several pieces at home to form the base saves time later at the campsite. My version used a square base, but feel free to modify the dimensions to fit your particular application. This system is assembled on the ground and set upright when completed. A T-shaped PVC piece is required in the center of the base to control the bottom of the vertical support. Two of the vertical support pieces must have 1/4-inch holes drilled through one or two inches from the end. Two 6-inch by 1/4-inch dowels inserted through the holes will secure the Slinky to either end of the PVC mast. The remaining sections with associated female connectors are assembled to make the vertical support. The PVC pieces with 1/4-inch holes in them are placed at the top and bottom of the vertical support assembly.

Insert a dowel into the lower section of the support; it can be held in place by a rubber band. Place the Slinky over the support, hooking a couple of coils over the dowel. Put the other dowel in the upper support, then stretch the Slinky along the full length of the PVC assembly, hooking a couple of coils over the upper dowel. Again, a rubber band can be used to hold the dowel in place. Place a PVC cross-shaped piece on the top. Attach lightweight guy lines to this tie point. (*Caution: Depending on how tall you have made the support, you may need guys in the middle to keep it from bending.* A PVC cross may be placed in the middle of the vertical support as a tie point. Experiment at home before going camping.)

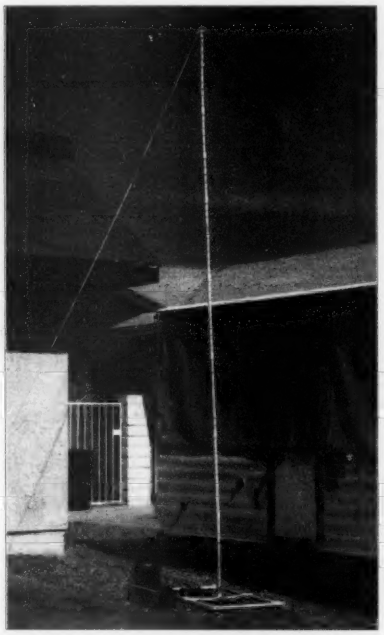


***Photo B.** Entire station set up at home, prior to going camping.*

Now the tricky part: Tie off two guys loosely with enough slack to allow the antenna to be placed upright. Stand the structure up and tie off the third guy. Now go to each guy and adjust accordingly. The antenna shown in the photos is 13 feet tall and works well with just top guys.

The Slinky will stretch taller; in that case you will need to guy the structure in the center. I've used it to 18 feet with two sets of guys. The length of the Slinky if it's stretched out is approxi-

mately 67.5 feet of radiator, close enough for a quarter wave on 80 meters. This configuration is a high Q design. To lower the Q and increase the bandwidth, add a capacitance hat. You can use a short vertical rod or a round piece of metal for the hat. The vertical rod is the easiest to use. Simply tape it to the PVC and use a jumper from the Slinky to the rod. If you plan on running high power, the hat is required.

If you camp where there is no place to anchor the guys, you'll need to improvise. I've used my spare tire, tools, the camping box partially filled with sand, a garbage bag with sand, or whatever was handy. The entire antenna system only weighs a few pounds but your anchors should be heavy enough to hold it in place if the wind picks up. Use your imagination and have some ham radio fun.

**On the air**

Well, that took 15 minutes, so let's get on the air. Gator clips were preinstalled on the coax so connect the center lead to the Slinky, the shield clip to the ground wire, and the other end of the ground wire gets thrown into the lake. When the lake isn't available I just make a wide circle around the base of the antenna. Either way, it radiates. You may want to cut radials for each frequency you will operate.

I've found most campgrounds don't have enough room to string out a standard set of radials. In this situation, run coax into the back of the rig. Hook up the rig to the coax, power supply, CW key, and mike. Turn on the power supply and the radio. Now the magic...check the SWR...ouch! Sure is high...unkey the radio, run over to the base of the antenna and move the clip on the center lead up the Slinky...recheck the SWR...ouch!...(still high, but better). Keep up this procedure until the SWR is acceptable.

If you want to save the running back and forth, here are two suggestions: 1) Use a tuner and you are on the air in minutes; or 2) Use one of the antenna analyzers on the market. It will tell you almost instantly how far off frequency the antenna is and makes the adjustments much easier and faster. I've used both methods and prefer the second.

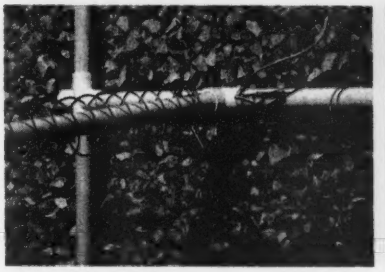


*Photo C. The left clip is from center lead of coax to Slinky; right clip is shield of coax to radial; 1/4-inch dowel holds Slinky in place.*

Complete campsite station requirements are listed in the sidebar. *Important: Know what kind of connectors you need to make everything work together before you leave home!* 73

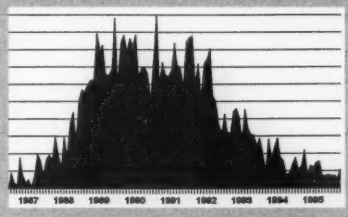
**Minimum Requirements for a Successful Ham Camping Trip:**

Transceiver
CW keyer
Microphone
Slinky™
Power supply with cables to attach to the radio (match power supply to the transceiver's requirements)
Guy lines (heavy twine works)
Guy line anchors
PVC (approximately 20 feet) with necessary elbows, tees, and crosses
Coax with clips installed on one end and proper connector on the other to fit the radio
Scratch paper
Log
Pencil
Ground wire/radials
Spare fuses

Optional:
Tuner
Antenna analyzer
Headphones
Speaker
Tape
Metal plate or rod


# Solar Cycle 23

Help is on the way for HF; cycle 23 sun activity have been spotted! We're nearing the end of cycle 22 now and NOAA predicts it may end in early '96. 22's rise took only 34 months! Of course, the **KAM Plus** is the ideal TNC to put to work in cycle 23! It has the best feature-price combination. No other reasonably priced multi-mode **operates simultaneously on HF and VHF at the same time!** With the KAM, you can operate an HF mode on port 1 while watching the DX cluster on VHF! And the KAM Plus runs G-TOR too, the newest and highly effective HF mode.



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represent amateur radio at the WARC conference at the ITU in Geneva?

Adventures like this are there if you keep your eyes open. And ears. Even ham visits to the Caribbean can be a ball. It doesn't cost much to get on the air from any of the islands down there. And the local hams are wonderfully friendly. But then you haven't bothered to send for my *Caribbean Adventure* book yet. Tsk. How about an inexpensive bed and breakfast on Montserrat, complete with an operating ham station and swimming pool?

Or the time I heard that King Hussein JY1 had gotten on the air. Most hams did nothing. I cabled him and asked if he needed some help with the pileups. A few days later I was on my way to Jordan and an incredible adventure.

So what's your excuse? Is it a lack of initiative? Laziness? No motivation? No determination? No guts? None of my adventures would have happened if I hadn't taken some initiative. I find you can do almost anything if you decide to and then stick to it. That's how I took off nearly a hundred pounds of lard which I'd been lugging around for many years. And I've kept it off.

But, you know, I get discouraged. When I preach adventure you head for the couch and a ball game with a six-pack in hand, or for a rag-chew about nothing on 75m. I try to explain how you and your family can live a long, healthy life and you get mad because I'm not writing only about ham radio. Sigh.

Maybe there is no way to motivate the grossly fat hams I see at hamfests to add years to their lives, or to get the average ham to even consider volunteering for an adventure.

I remember the time I organized a ham tour of Europe. 73 of us visited London, Paris, Geneva, Rome and Berlin, and we had a fantastic time. We had ham parties in every city except Rome, but we did have an audience with the Pope there. And we pulled off the whole tour for $550 a person, and that included nice hotels, great parties, and all flights. That was the normal round-trip tourist fare to Rome at the time, to give you some perspective on how inexpensive it was.

You won't believe how cheap you can travel unless you start reading my two $8 travel books.

I wanted to put on another European tour, but the ARRL had proposed what they called "Incentive Licensing" to the FCC and the whole ham industry was being destroyed. It was really tough on my upstart magazine when 85% of the ham radio stores carrying it went broke and over 90% of the manufacturers went out of business. Hams by the thousands, in a panic over the proposed legislation, sold off their stations for anything they could get for them, all in a couple of years. The hobby has never really recovered.

But even with the hobby in deep trouble I was having fun and adventure. I found a house for sale high up on the highest mountain in southern New Hampshire, just a few miles from my home. There I set up the darndest VHF ham station, with four big towers and huge antennas. On 2m I had 336 elements, fed by a kilowatt, and two kilowatts of audio for the AM signal. Talk about punch! My signal over the whole east coast was legendary. I worked walkies down in New Jersey, 250 miles away! Expensive? Of course not. I swapped advertising for the ham gear and towers, and had the help of $20 a week plus room and board college drop-out hams in setting up and operating it. We were all living and working in my 40-room house, with me cooking all the meals.

Now, let's talk about what adventures you've had so far. Adventure is right there, waiting for you.

Pioneering new communication modes is an adventure too. As soon as I heard about Jack Babkes W2GDG inventing narrowband FM, I modified a BC-459 exciter and was giving it a workout on the air. Now NBFM is mostly what we use on 2m and up.

I built an SSB rig and got on the air with 5 watts and a dipole antenna on 20m. My first contact was with Australia! And so it went with RTTY, slow-scan, and repeaters. I was the first ham on 6m in New York City. I helped W2BFD put up the first repeater in the east so all the RTTY gang could communicate. If you don't think putting up a repeater antenna on top of a New York skyscraper in a snowstorm in the middle of the night is an adventure, then take a look at the Municipal Building roof some time. It's copper-clad and has a 30° slant. I had to hold onto the little pegs fastening down the copper plates to keep from being blown off the roof. How about working seven states on 10 GHz with a tenth-watt little box for adventure? Or talking to hams all around the world via moonbounce using the thousand-foot dish at Arecibo?

Good grief, are you still just sitting there? There isn't one thing I've done that others couldn't. It's just a matter of initiative.

**More Surplus Coming?**

The FCC is considering "refarming" the frequencies below 512 MHz. By that they mean narrowing the bandwidths permitted. While the commercial companies providing the communications services will benefit by being able to service twice as many users, you can bet that the users of those channels will be fighting the move since it'll mean a massive obsoleting of their equipment. Users will have to get new rigs to meet the new restrictions.

It was just such a move about 35 years ago that obsoleted tens of thousands of taxicab radios and their communications systems, when they went from 30 kHz wideband FM to 15 kHz. It was this massive changeover that sparked the amateur radio 2m FM and repeater revolution. The first repeaters were on 30 kHz channels, starting at 146.64 MHz and going on up to 146.70 (which was an RTTY channel early in the game), 146.76, 146.82, 146.88, and 146.94. The 60 kHz separation allowed for the 30 kHz bandwidth of the users without too much interference from the adjacent channels.

It wasn't long before we had to go to narrowband FM, as pioneered by W2GDG back in 1946. He later formed Sonar Radio to market the mode and made millions. That allowed twice as many channels. And when those filled up we started using the 147-148 MHz segment too. Eventually that filled up, so we narrowed down our receivers even more, doubling the number of channels again. I won't get into a discussion on how much we're using all of those channels. I suspect that the goal for most hams is to have one channel for every ham for his repeater, and never mind that there is no one left to use it but him.

If the FCC is successful in forcing the commercial users below 512 MHz to buy new equipment, we're going to have a ball with all that cheap surplus mobile equipment. It's also going to be a bonanza for the equipment manufacturers, generating billions of dollars in sales. Of course this is going to tend to raise our state and federal taxes, because our blessed government is a big user of these frequencies.

The downside is that with all this great, cheap equipment, we may not have any frequencies left we can use it on. But that's pretty much up to you and whether you and your club are interested enough to put up a fight.

**The Internet**

I recently pointed out that the Internet is posing more and more competition to ham radio. Now you can chat with people almost anywhere in the world without any worry about QRM and propagation. And cellular telephones have taken away most of the need for our ham repeaters for emergencies, making them largely an improved CB type communications system for Techs.

Maybe what we need now is a special section on the Internet just for hams. We should set it up so it will provide the ability to make a contact with people around the world only when 20m propagation would normally permit it. We'd have a computer generate crosstalk, fading, and other normal interference, to provide realism. Contacts would be limited to one minute, tops. Of course we'd have simulated pileups on the rarer countries.

For further realism, we'd charge 10¢ a minute for a simulated 10-watt signal, 20¢ a minute for a 100-watt signal, and 40¢ a minute for a kilowatt signal. A California Kilowatt signal would cost a buck a minute, and be well worth it! How about 1-watt signals being free? Sure, why not?

This contest, like DXCC, could run 24 hours a day, 365 days a year. Hmm, if we figure that this would be restricted to 25 kHz of the 20m band, that would mean about five channels. This would take five channels on the Internet. No problem.

When I spent some time working DX from Afghanistan as YA1NSD I noticed that the Big Signal US hams were in there solid every night. The plain old kilowatts with triband beams came through about four

nights a week. The 100-watters maybe one night a week. The 10-watters maybe one night a month. That wouldn't be difficult to program into a computer.

All you'd need is the bucks and the time, and you'd have your 400 countries worked, just like on amateur radio. Once I got a kilowatt and a good beam working up here in New Hampshire I worked 100 countries in a week, 200 in a month, and 300 in less than a year. But then I had to take some time away from operating to put out *73*. With so many hams retired, many should be able to easily beat my record. I did once work 100 countries in a weekend on 20m phone, but that was during a contest. I just wanted to see if I could do it.

With the FCC under pressure from Congress to sell off as much of the spectrum as possible, and with us having more spectrum allocated than any other service, we'd better start making plans for meeting the communications challenges of the 21st century. But without counting a whole lot on using radios. Maybe we can at least keep the spirit of amateur radio alive via the Internet. Will Dayton have to hold yearly InterVentions?

**Is CW Dead?**

Somehow I've managed, in some minds (?), to come across as a CW-basher. Piffle. I'm a basher of the use of the code as the major barrier to keep new hams away from the HF bands. As I've mentioned, probably too many times, it was my code skill that saved me and my submarine during WWII. I have always championed the use of CW as a fun mode for hamming. It's great for DX contacts where English is a barrier. And, for those who are proficient, it's a great way to communicate.

If the code hadn't been mandated by the government I probably would have enjoyed it. But I have a serious, probably genetic problem. When someone forces me to do something that doesn't make any sense to me, I resent the hell out of it, and I resist. I've checked a couple of my past lives and, sure enough, I was a troublemaker there too. I had problems with my folks when I was young. "Because we told you to," wasn't enough of an answer when I asked why I should do something, even when it meant a spanking.

The Navy and I had some problems with this. They operate on this weird slave-type system of they tell you to do something and you do it. It took me a while to adjust the Navy to my thinking. Well, I didn't have much success with the whole Navy, just with those around me. Ask me and I'll do almost anything. Tell me, and you can go to hell.

Anyway, let's stop this stupid idea that I'm a CW basher. I do think it's a good idea for survival trainees to know the code, just in case. It sure helped Scott O'Grady get out of Serb-held Bosnia when his plane was shot down. But then he had to use voice to confirm his identity. You don't need to be a 35 wpm speed king for that, you just have to have memorized the Morse alphabet. And that only takes a few minutes put of a whole lifetime.

I do wish that there were more people who would demand reasons for doing things and not just meekly follow along, head down, sheep-like, doing whatever someone else tells them to. That's all it would take to clean up the lousy government we've allowed to build up. Can you point to one major social problem in America that hasn't been caused by the government you elected? And continue to re-elect? One? Hmm, let's see, what time is Roseanne on tonight? And The Simpsons?

**Pioneering Opportunity**

An item in a recent *Fortune* on how to cut your phone bill by 96% attracted Wily Wayne's attention. I'm not cheap, I'm just thrifty (Never Squander Dollars). So I looked into it. What VocalTec has is a software package ($59) which allows computers to send voice over the Internet to anyone else using the same software. It uses data compacting and allows one-way ham-type communicating anywhere in the world via the net. For $1 to $2 an hour vs. about a buck a minute to talk with someone in Hong Kong!

Instead of brooding over this latest Internet assault into ham territory, I said to myself, hey, how about using this cutie to narrow the bandwidth of our voice transmissions? If I don't start hearing the sound of this strange new data swapping on 20m soon, followed by some enthusiastic articles submitted to *73*, I'm going to put you down as being lazy, brain-dead, good-for-nothing, soap opera watching, beer swilling couch potatoes.

The system is set up to use a 486 PC with at least 8MB of RAM, Windows 3.1, WinSock 1.1 14.4kb modem, and a Windows-compatible sound card, microphone, and speakers. VocalTec is at 157 Veterans Drive, Northvale NJ 07467. 201-768-9400, Fax: 201-768-8893. E-mail: info@vocaltec.com. Okay, VocalTec, where's the Mac version? Drat!

**Curt LeMay**

I had a chance to talk with General LeMay, the head of the Strategic Air Command (SAC), one time at a Sideband Dinner in New York. Curt was blunt. And salty. Curt explained the facts of life to me, and they're worth repeating now. He explained that amateur radio existed as a "service" (read: hobby) for one reason and one f— reason only: The military wanted it. There were two reasons for our military support. Number one, the military wanted to have a bunch of frequencies available they could take over in time of war that weren't cluttered up with the much more difficult to move commercial and broadcasting services. Number two, in case of war they would need men with technical know-how to install, operate, and service electronic equipment.

He was right. At least he was right during the 1930s to 1960s. As I've mentioned, when WWII broke out 80% of the licensed hams

*Continued on page 42*


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## NEVER SAY DIE

*Continued from page 41*

joined the military, giving our country a tremendous technical edge over Japan and Germany. And it was our electronic technology that won that war. I was there in the front lines, so I know personally what a difference it made. We also donated our ham receivers to help the government. My SX-24 went to war in Brazil with the OSS' Rubber Development Corporation. And I went on a submarine, where I helped sink a lot of Japanese ships.

Today we hams have almost nothing to offer the military. Future wars will be high-tech, but they'll be short. It took us almost two years after WWII started before we really got going with effective radar and sonar. Heck, when I reported aboard the Drum in 1943 we were still using a TRF receiver for low band reception! That design was close to 20 years old by then.

The military has no further need for our ham bands in emergencies. Our ham equipment would be useless for them too. And I'll bet not one ham in a thousand could service the latest military electronic systems. Sure, we could field several hundred Morse Code experts if an enemy bombed us back to the stone age.

They had quite an article on LeMay in the *New Yorker*. It wasn't flattering, so I was just as happy that they didn't mention his being a ham operator (W6EZV), or his part in the promotion of SSB. According to the article LeMay was ready, with or without presidential authorization, to nuke Russia in a preemptive strike. I've written in my past editorials about how Art Collins WØCXX of Collins Radio, with the help of Don Merton K2AAA/W2UOL, got the Air Force to make SSB their standard for voice communications, beating out GE and John Costas K2EN with his technically superior double-sideband system.

**Help!**

Hey, some of you retired old timers, when it's too wet to play golf or the football game has been canceled on TV, if you have some art skills, maybe you could give me a hand in your spare time. I'd like to use more drawings, cartoons, and other ham-oriented artwork in *73*. I could even use some help in doing schematics, if you've got a good software program for that. Bandel Linn K8LAP did my cartoons for years, but he smoked, so he died in a nursing home. I met Bandel in 1950, when I was working at WASP in Sarasota (FL), where he did a talk show interviewing famous people living in the area. For instance, I got to know author McKinley Cantor through Bandel.

The two of them had a great friendship, with one always trying to outdo the other on practical jokes. Like the time Cantor bought a whole bunch of used books for a quarter each. He stamped Bandel's name and address in them, offering a reward for their return. He then left them all around the country in hotel rooms and stores where he was autographing copies of his books.

Let me know if you've managed to develop some art skills, or at least can handle computer-generated schematics for me. I want to make *73* more fun to read. Yes, of course I'll pay for the work. But not a whole lot. Remember that NSD stands for Never Squander a Dollar.

**Antenna Gestalt**

How would you, once and for all, like to actually understand how and why antennas work? The basic theory isn't complicated, once you go for the concept instead of being buried in operational details.

For instance, why do beam antennas have gain? Well, that's simple. We have to have a reference antenna to compare to a beam, so we use a dipole, which is a piece of wire cut to one-half wavelength long at some designed frequency. Now, if we're radiating 100 watts from an antenna, that 100 watts is going out in all directions. If we could have an antenna that acted like a point source, our 100 watts would be spread out evenly in a sphere.

So, if we put a mirror under the point source, reflecting back all of the energy normally going down, we'd have our 100 watts being distributed through just half of a sphere, so we'd have twice as much energy at any one point on the half-sphere. Thus, the more we can focus the energy from the antenna in one direction, horizontally or vertically, the more gain we're going to have in a desired direction.

For most of our antennas the earth (aka ground) acts as a mirror. It's a murky mirror, sopping up some of the energy instead of reflecting it all. So we often try to help Big Mutha do her reflecting work with a ground plane or, on the lower bands, a bunch of ground wires under the antenna. The less energy we spend heating the earth and reflecting back into space, the more energy we'll have available to get a signal out. And in, too. Antennas are reciprocal devices, which means they work just the same on sucking in energy as transmitting it.

On the lower bands we have a series of ionized layers of air a few miles up in the (surprise!) ionosphere. These are ionized by being zapped by energy coming from the sun, so the more sunspots Old Sol has, the more stuff that erupts from its surface in solar flares, and the more the earth gets bombarded by with ions. These layers also act as foggy mirrors. The stronger the ionization, the better the reflecting ability of the layers.

The higher we go in frequency, the higher the layer that will reflect our signals. This is why we have such a short range on 80m, and such a long range on 10m. The higher the layer doing the reflecting, the further the signal is going to be reflected. And then we're helped by it bouncing back and forth between the ionized layer and the earth's reflection, giving us multiple bounces.

And this is why, during sunspot minimums, the higher layers don't get enough ions from the sun to reflect our signals, so 10m dies, and even 20m is lousy at night. As soon as the sun's ions stop zapping the ionosphere, it starts to disperse, hence the different propagation at night. The higher layers disperse the easiest, so 10m fades out at night, even in very high sun spot parts of the 11-year cycle.

Once we get above the highest frequency these layers can reflect, which we call the Maximum Usable Frequency (MUF), we're up in the VHF and UHF bands and antennas are simpler to deal with.

On the lower bands you have two needs. One is to be able to hear signals from all directions when you want to. It's nice to have a clue as to what areas of the world the ionosphere layers are favoring. But then you want to concentrate as much energy into the one single direction as you can so you can be heard, and can hear the chap you're trying to contact and cut down on the signals from other directions. This is tricky. You want to concentrate your energy both horizontally in as narrow a beam as you can, and also vertically, aiming it upward at an optimum angle to bounce off the ionosphere. And that vertical angle is always changing as the layers go up and down, and different layers come into play at different heights. The ideal DX antenna would be steerable both vertically and horizontally. Well, that isn't difficult for the UHF bands, where your antennas are small. A half-wave at 2m is about 38" while at 20m it's obviously ten times that, 32 feet. That's beyond what we can practically do with an az-el rotator. Azimuth (horizontal). Elevate (vertical). We use those mostly for our satellite communications up on the VHF and UHF bands, where we zap right through all those ionosphere layers.

One of the problems with this vertical angle deal is that an antenna which works great during the high sunspot years because it has a particularly low angle of radiation, is a dud when the sunspots are low and the lower layers less ionized. For instance, the W8JK "Twin-Three" wire beam is a marvel during the high sunspot part of the cycle. It has a very low angle of radiation. I knocked the socks off the Big Signal boys with their yagi beams with this simple wire antenna. It's just a couple of dipoles spaced 1/6th wave apart. It's bidirectional horizontally, and doesn't have much more horizontal directivity than plain dipoles. But it had a very narrow vertical angle, and very low. The result was that my signal would be the first heard when the band was starting to open, and the last to fade out. But while the band was wide open, I was outdone by the yagi antennas.

So when everyone was working Europe, I'd call CQ the Middle East or the Indian Ocean. When everyone was working the Pacific Ocean and Japan, I'd be working far into China, South Africa and the Middle East the long way around. I remember working W5IMW portable in Tsientsin, China, running a quarter watt (AM!) to modulated signal generator into a longwire antenna. He

*Continued on page 45*

# The "J" Antenna

*An oldie but a goodie.*

Dale R. Kubichek N6JSX/9
1305A South 13th Street
Manitowoc WI 54220

The "J" antenna goes back many years, long before I became a ham. There are a bunch of reasons why you're going to want to build one of these beauts:

- It has a low, relatively straight-out angle of radiation.
- No ground plane is required.
- You can use it on several bands.
- It may have separate feeds for each band.
- It's very easy to make.
- It's inexpensive to make.
- It's fine for mobile, marine, or home use.

I run 2 meters and 220 MHz in the car, and I prefer a solid gutter mount over magnetic mounts. A 5/8- or 1/4-wave whip antenna on the gutter only has half of the car's body to act as a ground plane, but the "J" requires *no* vehicle ground plane.

The "J" is the *best* antenna for flatlanders, giving the most distance to your transmitted signal. This is due to the exceptionally low, to nearly flat, angle of radiation of about 0°-2°. The other, more common, antennas give much higher radiation angles; that may be good for mountaintop elevated repeater sites but will shorten your overall flatland transmitting distance. The 5/8-wave whip has about a 4°-6° radiation angle and the highest radiation angle comes from the 1/4-wave whip that has about 5°-10°. The "J" has approximately 3 dB of gain over a quarter-wave ground plane antenna and 6 dB over an isotropic (theoretical) antenna. The "J" can be made from almost any material: copper pipe, steel whips, and even 300 ohm TV twin-lead.

Technically, the "J" antenna is an end-fed half-wave antenna that uses a quarter-wave matching stub. Old-timers might call it an "end-fed Zepp," bent 90°. In actuality, the conductor is three-quarters of a wave long and the remaining section is a quarter-wave long. The matching stub creates the tuned half-wavelength antenna. Because the matching section acts as the matching transformer/balun, the half-wave radiator sees the lower quarter-wave

***"The "J" is the* best *antenna for flatlanders, giving the most distance to your transmitted signal."***

| | 146 MHz | 223.5 MHz | 446 MHz | |
|---|---|---|---|---|
| 1/4 Wave | 19.3" | 12.6" | 6.3" | computed |
| 1/2 Wave | 38.5" | 25.1 | 12.6 | values |
| Radiating Element | 57.5" | 37.5" | 18.5" | |
| Matching Element | 19" | 12.5" | 6" | |
| Coax Taps | | | | |
| Combo 2m/220 | 5" | 2.25" | n/a | |
| Combo 2m/220/440 | 4" | 1.75" | 1.25" | |
| Spacing Between Elements (ID) | 1.5-3" | 1-2" | 0.75-1.5" | |

(The spacing ID can be as small as 1/4", but the coax tapes' dimensions will be affected.)
NOTE: These same dimensions are also good for monoband designs—specifically for copper pipe "J"s.

***Table 1.** Copper Pipe "J" Antenna Dimensions*

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| | 144 MHz | 220 MHZ | |
|---|---|---|---|
| Radiated Element | 57.5" | 37.5" | |
| Matching Element | 19" | 11.75 | No tuning required |
| Coax Taps | 3.75" | 1.5" | No tuning required |

*Table 2. TV-Twin "J" Antenna Dimensions*

matching section as an image of a false ground plane. In best terms, the "J" is a balanced quarter-wave matching stub feeding an unbalanced half-wave load. The feedlines to a "J" can be almost anything (ladder line to coax). Through experimentation, I found RG-58/U coax to be quite satisfactory.

The "J" antenna designs I have built and tested are:

- 3/4", 1/2", & 3/8" copper pipe
- 144 & 220 MHz combo
- 144, 220, & 440 MHz combo
- 2m modified CB whip gutter mount
- 2m & 220 TV twin-lead 300 ohm
- 144 MHz monoband
- 220 MHz monoband
- 430 MHz Beacon/ATV monoband

The "J" antenna can be made of common 1/2" rigid copper pipe with copper tees and 90° elbows. These copper parts, plumbers' flux, solder, and propane torches can be obtained at most hardware stores. Copper pipe is easy to solder, which makes assembly a snap, and these materials will withstand a lot of abuse and weather.

**Modified CB whip "J" antenna**

For a mobile 2m "J," I used a Radio Shack™ 102" CB whip and cut it down to size. The whip comes with a 3/8" x 24 mounting bolt attached to the bottom of the whip that fits nicely into most Radio Shack (gutter, ball, or mirror) mounting clamps. I made the plastic insulators and metal support brackets. I drilled the electrical split-bolt connectors to slide on the whip and give mobility to the coax attachment for adjusting VSWR.

I've modified my initial 102" CB whip "J" antenna design even further by welding an "L"-shaped 10 gauge bent metal rod matching section only about one inch away from the whip. The bottom of the "L" was welded to the whip bolt-head making a clean, sturdy construction. This eliminated the metal support bracket fabrication and made the antenna more aerodynamically stable, reducing wind loading and stress on the vehicle mounting point. I found the other metal support bracket loosened due to vibration and excessive wind flexing of the antenna.

"hidden transmitter antenna," and building it is easy. You'll need:

- 60" common TV twin-lead
- RG-58/U coax (multiples of odd 1/4 wave length)
- Coax connector (PL-259 or BNC type for HTs)
- Soldering iron
- Paper hole punch

See **Table 2** for 144 and 220 MHz antenna dimensions.

***"The portable version can be rolled up into a coil and stored in your desk drawer, or even carried in your pocket."***

**Triband copper pipe "J" antenna**

On the three "J" antenna combo, I took the matching elements and placed them 120° from one another. This appears to help eliminate crossband RF desensitizing. Tune the 440 section first and then the 220 section with the 440 section disconnected, and so on. The rigidity of the copper pipe means that insulators between the matching stubs will not be required to keep the elements equidistant. Use silicone on the antenna feed points and coax for weather protection. After building this triband "J" antenna, one apartment-restricted ham took this design, added a copper pipe stand to the base of the combo antenna, and made it a hat/coat rack in the corner of his apartment. He ran the three coax cables along the mop boards to his ham desk, and he claims the antennas still work well even with a few coats hanging from the "J" elements. See **Table 1** for measurements.

**Emergency portable "J" antenna**

This antenna can be rolled up into a coil and stored in your desk drawer or even carried in your pocket. With a rubber band, paper clip, or thumbtack, the "J" antenna can be suspended anywhere. This antenna makes a fantastic sneaky

Install tap-offs at the indicated points and trim the matching element in small increments until you have the best SWR. Be sure to add a little length to the matching element if you're going to tweak the SWR. I have placed a TV-Twin "J" inside PVC plastic tubing for weatherproofing and making a rigged antenna. Paint the tubing black, put a hook on the top, and you have an invisible nighttime antenna. (The PVC tube *will* interact with the "J" so special tuning is required.)

*Special note*: Since 1984, when I began pushing the "J" antenna design in *ALLUSA* packet articles, I have seen many published articles covering the TV-Twin-lead "J" with many different antenna dimensions. What I've been able to discover is that the length of the coax attached to the TV-Twin-lead "J" directly affects the dimensions and performance of the "J" antenna. However, using a bazooka balun (i.e., tuned RF coax shield choke) at the feed point of the coax seems to nullify the variable effects of random lengths of coax.

**"J" beam antenna**

A copper pipe monoband "J" is the basic foundation for my extended three-element "J" beam design. This beam can be made from any monoband "J" design. See **Table 3**. My extended three-element design gives nearly as good a performance and gain (about 6 dB) as a four-element antenna. The matching element can be as close to the radiating element as practical (but any variance in this dimension will directly affect the coax

| | 144 MHz | 220 MHz | 440 MHz | 434 MHz |
|---|---|---|---|---|
| Director Element | 36.5" | 23.9" | 12.0" | 12.3" |
| Reflector Element | 40.4" | 26.5" | 13.2" | 13.6" |
| Director Spacing | 20.1" | 13.2" | 6.6" | 6.8" |
| Reflector Spacing | 12.25" | 7.9" | 4.0" | 4.1" |
| Center - 1/2 Wave | 19.25" | 12.6" | 6.3" | 6.5" |

*Table 3. "J" Beam Antenna Dimensions*

taps.) The antenna offers good directivity and the potential for some interesting mechanical methods of changing beam bearings. Remove the pins from the PVC, and the beam makes a great rotating hidden transmitter antenna. I have rigged this beam for a constant (2 rpm) slow rotation (using a 12 VDC windshield wiper motor), making the signal bounce and scatter all over the hills. I used a glass marble for a mock bearing between the top of the radiating element and the PVC end cap.

Since moving from my California home in 1993, I've been living in an apartment, unable to use outside antennas. I use "J"s for all my VHF/UHF/packet operations inside the apartment. Placing the antennas in the corners of the living room, hanging the "J"s from curtain rods (behind curtains), or using a TV-Twin "J" thumbtacked to the roof of the patio room allows good ham communications, and I can keep my PTM packet mini-BBS station (in Manitowoc, Wisconsin) on the air. The "J" antenna offers the foundation for stealth antennas; by placing the antenna in PVC, with a little paint and an angled mounting box, the antenna can look like a gas/sewer breather pipe on the roof of an apartment or CCR restricted house. I have found the 3/4" copper pipe "J" to have a broader bandwidth, and it's extremely sturdy, making it a good high-wind area antenna when solid coax attachments are ensured. A coat of polyurethane will keep the antenna bright for years.

Other good "J" antenna designs that have been published in *73 Amateur Radio Today* in recent years (in my opinion, the best "J" designs, offering the greatest potential, are the 2m & 440 dual-banders):

- "Copper Cactus J-Pole" by KE7AX, February 1992.
- "Copper Dual-Band Super J-Pole Antenna" by KAØNAN, April 1993.

Other interesting designs are:

- "220 Super J-Pole Antenna" by KAØNAN, May 1996.
- "440 Super J-Pole Antenna" by KAØNAN, April 1996.
- "Simple J-Type 10m Vertical" by W6IOJ, September 1995.

## NEVER SAY DIE

*Continued from page 42*

said I was the only one on the band he could hear.

Twin-Threes got to be fairly popular during the high sunspot part of the cycles, and then died when the spots died down. By the next cycle they'd all been replaced by higher angle radiators, so eventually the Twin-Three has been lost in history. You don't even see it in the antenna books any more.

### Ham Myths

An editorial in *Florida Skip* decried the decrease in technical competance brought on by the opening of the gates to no-coders, who the author, John Weatherly AB4ET, claims are flooding our bands. Alas, John, not having been licensed for long, has no way of comparing today's hams with those of yore. Having been there in yore, I know all about the vaunted technical competence of that era.

What a bunch of mitigated crap. The hams of the 1930s didn't know squat. They built their transmitters by copying articles in *QST* and *Radio*. Sure, back in the 1920s hams built their own receivers. But as soon as the first commercially made receiver hit the market they all stopped building and bought them. They had to build their own transmitters up until WWII because there no commercially made transmitters. Well, hardly any. Yes, National made a National 600 in 1939, but it was $600 and ran 600 watts. And that's like about $12,000 in today's dollarettes. It was a nice rig, with 100THs in the final. Thordarson power and modulation transformers. Nothing but the best, but not exactly what the average 6L6-using ham was looking for.

The big rig of the late 1930s was the QSL-Special, 6L6Gs on a chassis the size of a QSL card, with plates running red hot with the key down.

When I got interested in hamming I was a 14-year old kid, so I marked a map of Brooklyn with the location of every ham in the *Callbook* and I set about visiting as many of them as I could, zipping around the borough on roller skates. I listened on 160 and visited. I listened on 40m. 10m. There wasn't much doing above 10m, which was the microwaves of the day. I visited around a hundred hams and talked with them.

Here's a report on what I found in 1937-8. I found one ham who had built his own receiver. One. The rest had built their transmitters, but they had little understanding of what was going on in them. After they finished building their rig many of them had to bring it over to Cy W2IXY to see if he could make it work. His main piece of test equipment was a neon bulb.

So let's not perpetuate the myth of ham technical competence of yore, using it to try and make newcomers feel guilty and inferior.

The flood of war surplus in 1946 did more to help build ham competence than anything

*Continued on page 69*


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CIRCLE 75 ON READER SERVICE CARD

# Automatic Voltage Controller

J. Frank Brumbaugh KB4ZGC
PO Box 30, C/O Defendini
Salinas PR 00751–0030

Did something blow up in your regulated power supply and suddenly feed 25 or 30 volts into your expensive solid-state transceiver? Did you ever damage a storage battery by draining it completely? Here is a simple circuit that will cost only about five dollars to build, and will prevent damage to your equipment should your DC source voltage vary outside safe limits. The limits are defined usually as being +11.2 and +15 volts DC for most solid-state ham equipment.

This circuit can be thought of as a tireless "robot" that continuously monitors the DC voltage level of the power source for the ham station, whether storage batteries or regulated power supply. Because solid-state equipment can be damaged by excess voltage, and may not function properly when the supply voltage is too low, this "robot" will remove the DC voltage from the station equipment immediately should the voltage vary outside safe limits. At the same time, it will alert the operator with a red LED, and a bell or piezo warning, if included as an option. Thus, repairs and adjustments can be made immediately to bring the DC voltage back to safe levels. At that time this "robot" reconnects the DC voltage to the station equipment and indicates that all is well by turning off the red LED and the optional audible alarm and by illuminating a green LED. Operation is entirely automatic. Voltage limits are established by the circuit. Setting two trimpots for each voltage limit establishes calibration for normal operation, as just described.

## Theory of operation

Refer to schematic diagram **Fig. 1** for the following discussion. Station DC voltage, a nominal +13.8 VDC, is fed through normally closed contacts of relay K2. This voltage also provides power for the protective circuit illustrated. The voltage appears across R1 and R2, 10k trimpots, the wipers of which are set to exactly midrange, measuring a nominal +6.9 VDC. As the station DC varies between +11.2 and +15 volts, the voltage at the wipers will vary from +5.6 to +7.5 VDC. Zener diode D2 controls the high voltage limit of +15 VDC. R5 and zener diode D4 controls the low voltage limit of +11.2 VDC.

## High voltage limit control

A voltage is fed from the wiper of R1 directly to the base of Q1, which is held cut off by the 7.5 volt zener diode D2 from the emitter to ground. Thus, relay K1 is not energized, and its normally open contacts prevent relay K2 from being energized, thus allowing station DC current to flow through K2's normally closed contacts to the station equipment. However, should the station DC voltage rise to or above +15 volts, the voltage at the base of Q1 also rises to or above +7.5 volts, causing Q1 to go into conduction, energizing K1, its collector load, whose normally open contacts close, energizing K2, whose normally closed contacts open, removing the voltage from the station equipment. While the station DC voltage is between normal limits, the green LED D6

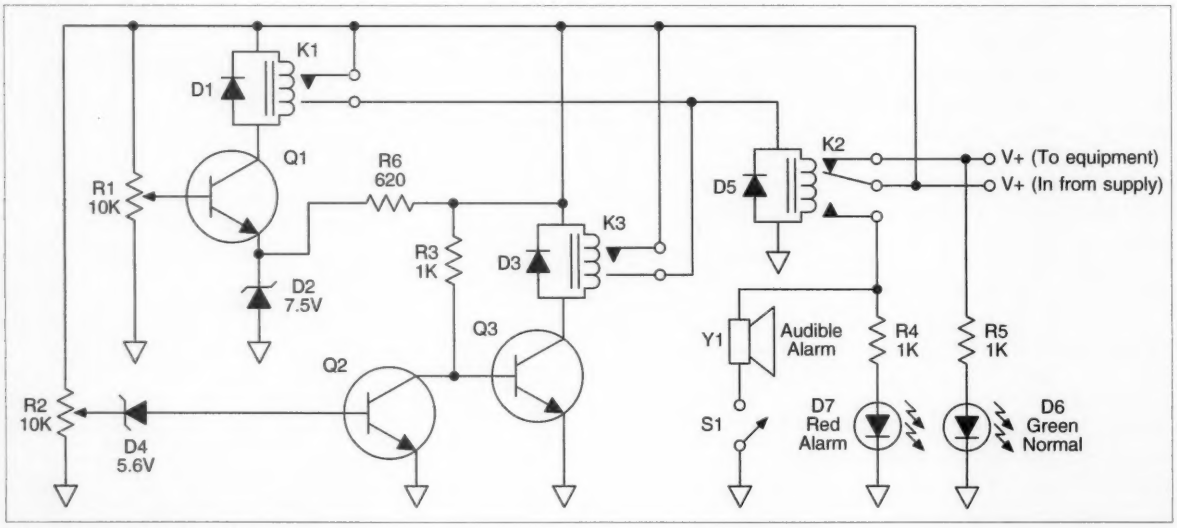


*Fig. 1. Automatic Voltage Controller*

will be illuminated, being powered through normally closed contacts of relay K2. When the voltage exceeds the high limit of +15 volts as described above, and relay K2 is energized, it removes voltage from the station equipment, the green LED D6, and applies power to red LED D7, and the audible bell or piezo alert, Y1, thus warning the operator of a power malfunction.

**Low voltage limit control**

A voltage is applied from the wiper of R2 to the cathode of zener diode D4 which conducts, causing Q2 to saturate. The collector of Q2 is connected directly to the base of Q3, which is cut off. Relay K3 is the collector load for Q3, and thus is not energized. Should the voltage fall to or below +11.2 VDC, zener diode D4 ceases to conduct, cutting off Q2 which causes Q3 to conduct, energizing K3. K3 applies operating voltage through its now closed, normally open, contacts to the coil of relay K2, which operates, opening its normally closed contacts, removing voltage from D6, the station equipment, and applying power to red LED D7, and the audible alert.

As described above, while station voltage is within the normal range, the green LED D6 remains illuminated. However, when the voltage falls outside the limits and relay K2 removes power from the station equipment and green LED D6, the normally open contacts of K2 apply power to red LED D7 and the optional audible alarm. Capacitor C1 damps relay chatter when the supply voltage is at either limit.

**Construction**

This instrument should be constructed in a metal or plastic case, with the LEDs on the panel where they will be easily seen by the operator. The optional piezo alert or 12-volt bell can be placed anywhere convenient. The toggle switch shown in **Fig. 1** should be included if an audible alarm is used, to cut it off until repairs can be made.

Relay K1 (high voltage detector) is actually a SPDT 6-volt relay with a 220-ohm coil, with only the normally open contacts used. Just about any 6-volt relay could be used, but I recommend this one for its characteristics and price. (All Electronics, PO Box 567, Van Nuys CA 91408-0567. Cat. No. RSD-6V. $1.00.) It is rated for 4.3 to 14 VDC, and where I used it in the circuit, the 4.3-V pull-in is important because of its rapidly operating to energize K2 and removing over-voltage.

Relay K2 (main power cut-off) is a 12 volt relay, and SPDT is required. The contact rating will be governed by the maximum current your transceiver draws from its power source. Of course, double-, triple-, or quadruple-pole relays can be used by strapping the contacts together to increase current carrying capacity.

Relay K3 (low voltage detector) has very little work to do, and can be any small 12-volt SPST N.O. relay, or an SPDT using only the normally open contacts. Any of the transistors listed in the parts list can be used. All of these will tolerate up to 6 volts between base and emitter, and a couple are rated for 7 volts.

Internal wiring can be any small hookup wire. Only the leads from your power supply to K2, and the lead from K2 to your station equipment must be commensurate with the current they carry, and the round-trip distance they traverse. The lead to station ground carries very little current. Check all wiring and connections against the schematic. Be certain!

**Calibration**

Adjust R1 and R5 to about the center of their rotation limits. Apply a DC voltage variable between at least 11.2 and 15 VDC between the top of R1 and ground. Set this voltage to 13.8 VDC. The green LED should illuminate. If it does not, adjust R1 wiper towards ground, and/or R5 wiper towards the positive end. When the green LED is illuminated, follow the directions below to set the desired voltage limits.

- **High Voltage Limit**

Set the variable DC voltage to 15 VDC, or the voltage you choose as high voltage limit. Use a DMM if at all possible for the greatest accuracy. Adjust R1 until the green LED goes out and the red LED illuminates. Set this point accurately to where the red LED just illuminates.

- **Low Voltage Limit**

Set the variable DC voltage source to 11.2 VDC or whatever voltage you choose as your low voltage limit. If the green LED is illuminated, adjust R5 until it just goes out and the red LED illuminates. If the red LED is illuminated, adjust R5 until it goes out, then carefully adjust R5 until the red LED illuminates.

**Operation**

Operation is entirely automatic, with automatic reset. Adjustments, other than the initial calibration described above, are neither necessary nor possible. This is as idiot-proof as it was possible to design it.

**Conclusion**

This is a junk box project for most hams, and whatever isn't in the junk box can usually be found at hamfests and Radio Shack™, or from other hams and the many mail-order parts suppliers. A piece of perfboard or a small universal board such as the Radio Shack 276-150 can be used to mount the small parts, including K1 and K3, most likely. But mount it in a metal or plastic enclosure to make certain nothing metallic can fall across any relay contacts.

With this tireless "robot" guarding your expensive solid-state equipment from dangerous and expensive voltage excursions, you are also protecting your wallet from unnecessary and easily avoidable expenditures. 73

**Parts List**

| | |
|---|---|
| C1 | 25µF 50V electrolytic |
| D1, D3, D5 | IN914, IN4148 |
| D2 | 7.5V zener |
| D4 | 5.6V zener |
| D6 | Green LED |
| D7 | Red LED |
| K1 | 6V SPST N.O. 220Ω coil (see text) |
| K2 | 12V SPDT, heavy contacts (see text) |
| K3 | 12V SPST N.O. relay |
| Q1, Q2, Q3 | NPN 2N2102, 2N2218A, 2N2219A, 2N3904, 2N4401, 2N5320 (see text) |
| R1, R2 | 10 KΩ trimpot |
| R3, R4 | 1KΩ 1/4W 5% |
| R5 | 620Ω, 1/4 W, 5% |
| S1 | SPST toggle or slide switch (optional) |
| Y1 | Piezo alert, 12V bell, etc. (optional) |

# Receiver RF Preamp

*There is a way to improve that old receiver's performance.*

Roland Burgan KB8XI
RR 1, Box 43
Hancock MI 49930

Have you ever wished that you could improve the performance of that older receiver you have sitting on the shelf, but couldn't find an easy way to do it? Over the years, many of us have looked into various ways of improving vintage receiver performance, but improving one aspect often came at the expense of introducing other problems. And as solid-state devices came along, we discovered that low voltage DC wasn't generally available in the tube-type equipment, often putting the final damper on the project.

But there is a way to improve performance. The circuit described here is simple, small, and can easily be accommodated in most receivers. It will provide 30 dB of broadband RF gain to the receiver's front end, at extremely low internal noise figures. The parts are readily available, and it can be built for less than $10.

## The circuit

The RF broadband preamplifier (**Fig. 1a**) makes use of an NPN VHF transistor, NTE123, as an untuned broadband (0.5 MHz to 30 MHz) RF amplifier. Input impedance is 50 ohms, allowing usage for all receiver inputs, and the unit has a 600 ohm output to match virtually all RF input circuits. The preamp delivers 30 dB of gain at 10 MHz, with a noise factor below 1 dB.

Power for the preamp may be obtained from a variety of sources. The assembly requires from 9 to 14 VDC and draws 8 mA of current. This makes it ideal for use in battery-operated portable equipment. Early tube-type receivers used filament voltages of 6.3 and 12.6 VAC, but had no low voltage DC power supplies. **Figs. 1b** and **1c** show how to "borrow" a little of the filament voltage, which is rectified and regulated to provide filtered 12 VDC for the preamp. In the 6.3 VAC version, diodes D2 and D3 act as a simple voltage doubler to step the input voltage up to approximately 15 VDC.

While the 220 µF caps used for the voltage doubler are sufficient for the load presented by this preamp, they will not provide the +15 VDC to the input of the regulator at more than about a 25 mA load. If other circuits will be used with these DC power sources, then the 220 µF caps should be increased accordingly. (2200 µF will provide about 65 mA regulated output).

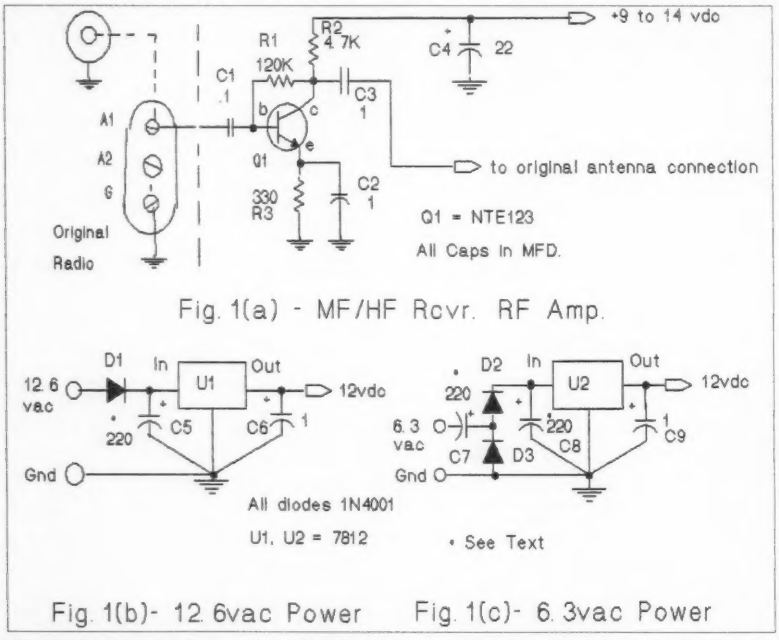


***Fig. 1a) MF/HF receiver RF amp; b) 12.6 VAC power; c) 6.3 VAC power.***

## Construction

In my installations, I make up two separate PCBs, one for the preamp, and another for the power circuit, to make better use of internal mounting space. The preamp should be mounted as close to the antenna input as feasible. Construction is not critical, and point-to-point construction may be used. Most preamp mountings will require nothing more than a right angle clip, while the power boards can usually be mounted to a back panel with standoffs. All other parts are standard values, but electrolytic caps should be rated at 35W VDC. Please note that the collector of Q1 is also internally connected to the metal external case.

The author may be contacted by mail (enclose an SASE) at the address above, or via E-mail at: rburgan@grfn.org .

**Parts List**

| | | |
|---|---|---|
| R1 | 120k, 1/8W | Mouser, Radio Shack |
| R2 | 4.7k, 1/8W | Mouser, Radio Shack |
| R3 | 330k, 1/8W | Mouser, Radio Shack |
| C1, C2, C3 | 0.1 µF, 50V | Mouser, Radio Shack |
| C4 | 22 µF, 35V | Mouser, Radio Shack |
| C5, C7, C8 | 220 µF, 35V | Mouser, Radio Shack |
| C6, C9 | 1 µF, 35V | Mouser, Radio Shack |
| Q1 | NTE123 (NPN transistor) | Mouser |
| U1, U2 | 7812 (1.5A Pos. 12V reg.) | Mouser, Radio Shack |

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# HAMS WITH CLASS

*Photo A. Rosalie White WA1STO with Matt Bordelon KC5BTL, a*

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

## Dayton HamVention '96

The Dayton HamVention is an event I look forward to all year round. This year I was particularly excited about moderating the Instructors' Forum on Friday afternoon. I had put together an impressive group of talented speakers, and I couldn't wait to meet with them. Besides being experts in their own areas, they are all high on my list of great folks I look forward to seeing.

At this yearly forum we attempt to present a variety of ideas, suggestions, and proven techniques to share with other teachers. Both classroom teachers and instructors in licensing classes can really get some good practical ideas at this workshop.

First I introduced Rosalie White WA1STO, head of the Educational Activities Department at the ARRL. She presented an overview of the package of materials that the League has to offer the teacher. I've personally used so many of the great lessons, charts, guides, etc., from this package of materials that I can vouch for their excellence. There is a wealth of information about amateur radio out there. The ARRL Education Department is a good place to begin gathering your data. Ask for Rosalie or anyone else in her department for assistance in getting a radio program started.

Next to speak was Ellie Van Winkle NØQCX, from Boulder, Colorado. Ellie is a retired kindergarten teacher whom I met four years ago at Dayton. We bonded instantly, and have had great success working together for the Dayton Youth Forum. She and her husband, Rip NVØM, created the BARC Jr. club for youngsters interested in ham radio. This group is one of the most successful youth groups in the country.

*"Ellie and Al Severson WB2PRZ spoke about how to have successful fund-raisers."*

Ellie and Al Severson WB2PRZ spoke about how to have successful fund-raisers, an important issue to any growing club that needs to support its members in different activities. Since BARC Jr. sent four children to participate in my Youth Forum this year at Dayton, they really had to get well organized in their fund-raising efforts. Besides having swap tables, raffling a donated bicycle, and soliciting donations, BARC Jr. also received a donation of frequent flyer miles, which helped defray the airfare. It was apparent to all in attendance that the dedication of the parent club, BARC, is a major factor in the success of the children's group.

Bob Heil K9EID, one of my favorite professor-speakers, wowed the audience with his antenna theory demonstrations. He used two microphones to demonstrate phasing, along with a dramatic flashlight-phasing demo. Bob is the recipient of many awards including the 1982 "Ham of The Year" award and the Pioneer Award for his groundbreaking work as a sound systems developer and engineer for such major groups as The Who, Peter Frampton, The Doobie Brothers, and many more.

Bob is so enthusiastic about the role of teachers in amateur radio, it's always a pleasure to have him as a guest speaker.

Bill Pasternak WA6ITF, who is the author of hundreds of technical articles, and was the 1989 "Ham of The Year," spoke about why he created the "Young Ham of The Year" award. He felt it was important to honor youngsters who were actively contributing to the hobby. Bill spoke about the qualifications for nomination and how to get an official entry form. For more details about this contest, contact Bill at 28197 Robins Ave., Saugus CA 91350, or telephone 805-296-7180.

The Instructors' Forum is always informative and fun to attend. Why not plan to attend next year?


## Radio Bookshop

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# HAM TO HAM

## Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108

In "Ham To Ham" in the June 1996 issue of *73*, I mentioned a practical use for those small laser pointer pens—using one to help locate a soldering pad on the foil side of a circuit board by shining its beam over the part to be unsoldered on the component side. I asked for other interesting uses, and I received this from **Harry SMØVPO** in Upplands, Sweden: "Those little laser pointers are about the easiest way that I know of to catch a fly! That's right, just shine it on the little bugger's head and it can see nothing else but the laser; now you simply pick it up! If you've ever wanted to catch a live fly—without damaging it—for study under a microscope or for macrophotography, this is the best method I've found ... I even have the pictures to prove it!"

Now there's a novel use ... from the land that gave us the zipper!

### Well grounded!

Here's an easy "quick modification" to keep in mind the next time you have your ham transceiver—or other accessory piece of gear—apart on your workbench. Check to make sure that the area on the inside of the metal cabinet covers is capable of making good ground contact when the cabinet covers are fastened back into place. It may seem obvious at first, but I've noticed that most ham manufacturers are guilty of "over-spraying" the insides of the cabinets during the cabinet spray-painting process. This over-spray can vary from very light to quite heavy ... depending upon luck, I suppose. At any rate, sanding, scraping, or otherwise cleaning the areas on the cabinet's inside can sometimes increase the RF shielding properties of the enclosure dramatically.

Those areas, especially around the screw holes, should be scraped clean—down to shiny metal—of any paint over-spray in order to assure good RF ground contact when the outside screws are tightened. I like using a small, hand-held "motor-tool" (such as the one made by Dremel) with a conical burr-style grinding bit in it for the job; it makes it fast and accurate.

Remember, what might be a reasonably adequate ground at DC and audio frequencies may not be effective enough at RF frequencies, especially at the VHFs and beyond. A little effort brings a lot of peace of mind.

### An unwelcome battery load

**Erich Kern** of Murrieta, California, wrote:

"It was interesting to me to read your piece on conductive adhesives in the November 1995 'Ham To Ham' column. I, too, have had occasion to encounter the same effect, but with masking tape instead.

"About 20 years ago, I learned quickly that some masking tapes can become semi-conductive after a time, creating unexpected leakage paths. In my case, I was using the masking tape to cover the exposed terminals of spare 9 volt batteries, only to find that the tape eventually became partially conductive—measuring about 20k ohms with the probes spaced 1/2 inch apart across the tape. Needless to say, the 'protective tape' was also discharging my spare 9 volt batteries! It's difficult to say whether the tape adhesive was the culprit (after it dried out to some degree) or if the paper-based masking tape merely picked up moisture from the atmosphere and then became a semiconductor. Whatever the reason, others should be aware that the problem can and does happen under the right (?) conditions."

*Moderator's note: In the May 1996 HTH column, I made the suggestion of using Johnson & Johnson's 1/2-inch-wide waterproof First Aid tape on conductive pathways, instead of other tapes that might become hygroscopic or otherwise semiconductive with time. I've been very happy with this product in my own equipment so far. Are there any other tapes that readers have used with long-term success, ones that don't become goopy after a while? Also, I ran into the conductive adhesive pitfall again. This time it was in a computer color monitor that I purchased at a local hamfest. The manufacturer had used an adhesive on some of the components that he didn't want to move during shipping, but, with time, it began to get semiconductive when it hardened. It became noticeable in the horizontal deflection section of the monitor, causing the width of the screen's raster to change unpredictably from time to time. Once I removed the problem adhesive (which had become very hard, brittle and probably hygroscopic), the problem was corrected ... Murphy strikes again! 100% silicone bathtub sealant seems to be best for holding down heavy parts on PC boards; it will last virtually forever and doesn't pick up moisture. Just take care to let it cure for the time recommended by the manufacturer before applying power to the circuit, and don't use it directly on the copper foil itself because of the acidic chemicals that it contains.*

### Ridin' the rails

I ran across a product that model railroaders often use, but which may also have practical application within ham radio. It's called Rail-Zip™ and is made by Pacer Technology, 9420 Santa Anita Avenue, Rancho Cucamonga CA 91730-6117 (1-800-538-3091). It's a multi-purpose liquid product that cleans, lubricates, conditions, and protects metal surfaces from mineral scale and rust.

I've used it on a small Z-gauge layout that I have, and it seems to work. Model railroad track has the tendency to become a poor electrical conductor due to the "micro-sparking" (my term) that goes on between the engine's pick-up wheels and the track every time it's run. Rail-Zip is supposed to penetrate the corrosion that's behind this tendency, and restore proper conductivity. It's also claimed to help prevent new corrosion, which will minimize future sparking for 8 to 12 weeks. Sound like it might be useful for connectors and switch contacts in our ham gear?

I wrote to Pacer, out of curiosity, and this is a paraphrased summary of their reply:

"Rail-Zip penetrates to produce a clean metal surface, leaving an organic barrier that prevents further scale from forming. It's formulated for use on all metallic surfaces, and is pH stabilized, water soluble, and safe around plastics. An oxygen scavenger works as a corrosion inhibitor to prevent cavitation, erosion, and pitting on metallic surfaces. It's completely organic, biodegradable, environmentally safe, and non-toxic to handle. Though not tested on connectors and switches used in amateur radio equipment, we feel that it will restore the electrical conductivity of them, and provide a corrosion barrier as well."

It might be worth keeping in mind, especially for outdoor antenna connections where corrosion can often be a big factor in intermittence; Rail-Zip is available at hobby stores and via mail-order from catalogs that cater to the model rail hobby.

### The right packet path

**From William Thim N1QVQ:** "Having been involved in VHF packet for a couple of years now, I've become conscious of a lot of hams who might be newer to that mode, questioning on 2 meter packet and voice what's available in the way of node hopping, BBSs, HF gateways, etc. in our area. I usually jump in and try to help with tales of my own experiences, but if it's on a repeater, more often than not the station is mobile, and unable to write down the information that I might have to pass on.

"In view of that limitation, I've taken to placing special information messages on my home PBBS, addressed to ALL, but only within my home district. A short description of the subject also helps, such as NODE HOPPING or perhaps HF GATEWAYS. I know that a significant number have benefited from these messages, and I've benefited myself with additional information coming back to me

from others who know of paths that I wasn't aware of. It pays to share!"

### Freebie sealant!

**From Bob Boehm N8EXF:** "Here's a readily available source of sealing compound for those outdoor coaxial cable connectors or weather-exposed antenna relay control boxes ... and it's free for the asking. It's the windshield edge sealant used by the aftermarket automobile windshield replacement guys that you see in people's driveways, replacing damaged windshields right on location. I was able to acquire a nearly unlimited supply of this sealant simply by asking one of the repairmen for any 'tail-end' rolls that he had lying around; rolls that usually just end up in the dumpster.

"Since locating this 'free' source, I've been using it exclusively for the past six years on all of my outdoor coax connections. While it isn't 'flat' in its acquired form, it's easily reworked, with just the fingers, to make an effective sealant for even the tightest of nooks and crannies. If you're worried about any adverse chemical reactions between the sealant and the metal on the connectors, simply wrap the connector first with one layer of electrical tape before applying the auto window sealant. It also makes for a 'cleaner' removal should you ever want to open the sealed connection for some reason. You can't beat the price, and it gives you a chance to tell a prospective newcomer (the windshield repairman) about the wonders of the world of ham radio!"

### Broaden your scope!

**From Michael Fratus:** "Even an inexpensive oscilloscope can be made to act more like one of the very expensive ones with a little ingenuity! Many of the 'big dollar' scopes offer on-screen voltage and frequency measurement as part of their selling points, but you can have nearly the same features for a lot less money.

"By using a couple of inexpensive BNC 'T' connectors on the scope's input, you can easily hook up both your DVM and your external frequency counter, so that you'll have a voltage and frequency reading—along with the scope presentation—wherever you place your scope probe during troubleshooting. It's a good deal easier than trying to read DC voltages by the amount of bounce on the scope trace, and frequency by converting microseconds into megahertz! And it surely beats paying $8,000 for a later-model scope!"

### Parts hunting made easy

**From Peter Albright AA2AD:** "One of the greatest challenges in any servicing endeavor (ham radio equipment included) is in identifying parts and finding serviceable replacements for defective ones. The manufacturer's technical service manual (of course) should be consulted first, if available, but what if you don't have access to one? My favorite semiconductor cross-reference is the EGC Master Replacement Guide, which is just chock-full of semiconductor data in almost 'painful' detail! It's less than $10 if purchased new, but it can sometimes be acquired free from service shops (when a new one comes out) or from some parts dealers, if you're a high enough dollar customer. ECG is a division of North American Philips Corporation, and you can contact them at: Philips ECG, 1025 Westminster Drive, Williamsport PA 17701. Incidentally, the ECG parts numbering system has also been adopted by several other 'generic' parts suppliers.

"The SK semiconductor parts series (from the former RCA Corporation) is also often used or quoted in replacement data as something of a standard, very much like ECG. The SK Replacement Cross-Reference is now available from: Thompson Consumer Electronics, 2000 Clements Bridge Road, Deptford NJ 09096-2088.

"Radio Shack also publishes a semiconductor replacement guide. It's available for sale or in-store use at most Radio Shack retail outlets. It usually only details parts actually being currently sold by RS stores, but it also contains a reasonably complete general cross-reference section.

"Because of their widespread presence, I'll often frequent my area Radio Shack stores first, when looking for replacement parts. Their parts are generally name-brands, simply repackaged in single or double lot bubble packs, but you can't beat the convenience and speed of obtaining a replacement in a number of cases. If they don't have what I need, however, I'll turn to the mail-order houses. One of my personal favorites is MCM Electronics, 650 Congress Park Drive, Centerville OH 45459-4072 (1-800-543-4330). They offer a good selection of parts, power supplies, tools, test equipment, computer accessories, etc. in their free catalog.

"Other suppliers that I've used include: American Design Components, 400 County Avenue, Secaucus NJ 07094 (1-800-776-3700); Black Box Corporation, P.O. Box 12800, Pittsburgh PA 152421 (1-412-746-5500); Fox International, 23600 Aurora Road, Bedford Heights OH 44146 (1-800-321-6993); Jameco Electronics, 1355 Shoreway Road, Belmont CA 94002-4100 (1-800-831-4242); Jensen Tools, 7815 S. 46th Street, Phoenix AZ 85044-5399 (1-800-426-1194). Tucker Electronics, 1717 Reserve Street, Garland TX 75042 (1-800-527-4642 Nationwide, or 1-800-749-4642 within Texas) carries a good line of test equipment, ham gear, computers, and accessories.

"The above listing is by no means complete, but I've personally found these suppliers to be reliable, often having the correct parts that I've needed in my repair work."

*Moderator's note: In addition to the suppliers Pete mentioned, Digi-Key Corporation, 701 Brooks Avenue South, P.O. Box 677, Thief River Falls MN 56701-0677 (1-800-344-4539) has a thick (free) catalog of parts and semiconductor components for the asking. I've had very good experiences over the years ordering from them and I love the name of that town!*

### A pin-up beauty!

**From Klaus Spies WB9YBM:** "Often, when designing a new home-brew item, or if repairing a factory-made piece of equipment, I've done some head-scratching trying to remember the standard resistor values available. But here's a chart that makes it much easier, so I'd like to share it with my fellow builders. See **Table 1.** It applies to both resistor and capacitor standards.

"All of these values are then followed by the appropriate multiplier, for example: 4.7 47 470 4.7K 47 K 470 K 4.7 Meg.

"When 10% resistors were the norm, every other value was skipped, beginning with 1.1, then 1.3, 1.6, 2.0, 2.4, etc.

"Today, with 5% resistors as the norm, the values shown in the chart are commonly available from the larger suppliers.

"For those who might be curious as to how these values were arrived at, this is the mathematical explanation:

"(1.0 + 5%) = 1.05, and (1.1-5%) = 1.045.

This implies that if one value of resistor is at the high end of its tolerance, it will overlap with the next higher standard value. This allows a person to pick almost any value required for a particular project, even if the tolerances are demanding, presuming that you have enough stock in the various values to choose from.

"By the way, experience has shown me that today a new, unstressed resistor is seldom at the

**Standard R/C Value Chart—**
**use multipliers as required:**

1.0 1.1 1.2 1.3 1.5 1.6 1.8 2.0 2.2 2.4 2.7

3.0 3.3 3.6 3.9 4.3 4.7 5.1 5.6 6.2 6.8 7.5

8.2 9.1 10.0

*Table 1.*

extreme of its tolerance range. In fact, modern metal-film resistors can be almost dead-on many times value-wise."

*Moderator's note: I've pinned up Klaus' chart over my workbench—how about you?*

### Etceteras

If you're looking for a Heathkit part at some point in the future, you can try calling Heath's parts order desk at 616-925-5899. Heath has sold some of its parts stock to Spectrum Electronics, so if Heath itself doesn't have it, then try calling Spectrum at 616-742-0613. This isn't an ad for either vendor; it's simply intended as potentially needed information for fellow hams.

### Tape tips

**From Steve Thacker KB5VCA:** "In my professional career as a superintendent for a mechanical and electrical contractor, I've come upon a number of types of tape for use in outdoor electrical situations, some of which might be of help to my fellow hams. Everyone has probably heard of, and perhaps used, Scotch™ No. 33 electrical tape; it has particularly superior stretching ability in cold weather, won't harm copper or aluminum, and can be sealed even tighter with Scotch 1602 spray sealer. 3M also makes a nice 'splicing' tape; it's a two-sided tape—one side is soft (like a good rubber tape) and the other is much harder and more weather-resistant. It 'cures' over a short period of time into an effective outdoor splice, the harder outside layer taking the brunt of the elements. Other manufacturers may make similar products; the 3M numbers are simply to give readers a point of reference from which they can start. Most electrical supply houses, and now some of the larger home centers, carry these products for shopping ease."

### Cheap power zener replacements

**From Richard Measures AG6K:** "Most HF linear amplifiers have a relatively high-power zener diode in the cathode circuit of their output tube (or tubes) for biasing them into the linear portion of their operating curve and for providing a stable, fixed cathode bias. This zener diode is prone to zapping out, particularly if a high-power VHF parasitic oscillation should occur, because of the large grid-current pulse that always accompanies a VHF parasitic arc-over. It's a costly and sometimes difficult-to-find component to replace. A better solution lies in the use of ordinary silicon rectifier diodes; here's why: 1.) Zener diodes are not adjustable; 2.) Zeners are relatively sensitive to high-current pulses; 3.) And, as mentioned, higher-power zeners are expensive and harder to find.

"Fortunately, the substitution of ordinary silicon diodes addresses all of these objections. Since ordinary power silicon diodes have a stable forward voltage drop of about eight-tenths of a volt DC (0.8 volts) across each diode, a series string of these relatively inexpensive diodes can be cascaded—to make up a stable cathode-bias regulator, for virtually any voltage required. Additionally, this 0.8 volt step-range gives you some desirable leeway in customizing a replacement circuit for your own particular linear amp. Now, by simply adding or subtracting diodes from the string, you can adjust the zero-signal anode current for your particular amp and tube combination parameters (guided by what the tube manufacturer recommends as the ideal idling current for that particular tube type). That's something you can't do using a fixed-voltage-power zener. Here's a quick example:

"Seven silicon diodes will provide a stable cathode bias of 5.6 volts (7 times .8 volts), 8 diodes would give 6.4 volts, 9 would yield 7.2 volts, and 10 silicon diodes would provide an even 8 volts.

"You can make up a small perf board layout for the diodes, say 10 diodes in all, then, with just a wire jumper, bridge out the ones that aren't needed, in order to arrive at the target anode-current 'idle' figure that you're seeking. If a new tube (or set of tubes) later on changes this figure significantly, you can readjust the idle current by simply moving the jumper.

"And don't forget, we're utilizing the 'forward voltage drop' of the silicon diodes—as opposed to the 'reverse voltage drop' in the case of the zener we replaced—so that the banded cathode end of this new stack will go to the point where the anode end went before, that is, just exactly opposite of the way the zener was wired into the circuit. You can use virtually any PIV rating for the diodes, since the voltage at the cathode is very low. The current rating of each diode in the string, however, should safely exceed the maximum expected cathode current, up to 3 amps maximum. Here's a final advantage: If you should happen to be the unfortunate victim of another high-energy parasitic pulse, it's a relatively simple matter to replace the diode or diodes that may have suffered the brunt of it ... and again, with a whole lot less cash outlay!"

We end this month's column after another of Rich's worthwhile ideas. Watch for many more in the months to come. If your idea isn't in here, why not? Everyone has run into interesting problems and found their own unique solutions to those problems. If you'd like to share yours with other readers, send them to me at the address above and I'll let you know promptly whether it will be used or not, and roughly when. The column is prepared a few months before the time that you read it because of magazine layout and printing considerations, so don't expect to see it next month, but chances are good that it will be used in a near-future issue. So click on the word processor program icon in your computer, and write a few lines about your favorite tip, technique or shortcut ... don't forget!

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Please send all correspondence relating to this column to *73* Ham To Ham column, c/o Dave Miller NZ9E, 7462 Lawler Avenue, Niles IL 60714-3108, USA. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73*. We will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to this column's moderator nor to *73*. 73

# ABOVE & BEYOND

## VHF and Above Operation

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### Adjuncts and other paraphernalia

This month's topic is adjuncts and paraphernalia that can be added to your equipment, making microwave operation easier with Wide Band FM (WBFM). Just having a transmitter and receiver rolled into a single neat package doesn't guarantee you'll make successful contacts. A few other ingredients are necessary, especially for those with the simplest equipment. By "simplest equipment" I mean the burglar alarm type of Gunn diode oscillator and detector arrangements, not the highly coveted Microwave Associates varactor-tuned Gunnplexers™.

The simple Gunn diode cavity devices are frequency dependent and must be adjusted to a set frequency in the amateur portion of the 10 GHz band. The units are aligned with an absorption type wavemeter before operation. Once frequency is set they have a narrow window over which voltage can be varied on the Gunn oscillator to make fine frequency adjustments. These frequency adjustments can move the basic oscillator over a 3 or so MHz frequency range at best. Primary accuracy is essential and must be set properly with the wavemeter type of frequency meter.

The varactor-controlled units like the Microwave Associates' Gunnplexers are premium units and offer frequency agility over a 60 to 80 MHz frequency range. If one end of your circuit has one of these units, other hams will find you, even if you are off frequency, and still make contact. The biggest problem with the burglar alarm type of Gunn oscillator is that you have to monitor the voltage tune pot for frequency disparities. If you like to tinker, read on; if you want to have an excellent unit, purchase the M/A unit. You decide what's best for *you*.

A nice addition to the operating unit is a wavemeter, coupled to an RF power meter amplifier, to increase the sensitivity of the wavemeter. Another test fixture is the twiddle tone generator. This device puts a distinctive tone on your transmitter through the audio amplifier modulator circuit, allowing weak signals a little better detection ratio when you are hunting for them in the noise. Other useful items are some good grid-square map locations of other stations, an ordinary compass, and other similar aids to help you aim a microwave signal towards a distant station accurately.

Each time you eliminate or reduce uncertainty in the microwave arena, your chances for a successful contact improve. The list of basic uncertainty items includes Gunn frequency accuracy, 30 or 88 MHz IF offset properly set, system sensitivity, and accurate compass bearings to the distant station. These are the main wobbles in the basic system and need to be addressed using some test equipment, plain old experimentation, and technical improvements.

The Gunn diode oscillator frequency can be set with a cavity wavemeter covering the 10 GHz frequency ranges. Rotate the drum dial, which changes the internal size of the cavity chamber (coupled to a section of waveguide). At various increments, the drum's outer surface is calibrated in frequency, reflecting the different cavity sizes as it's rotated. The cavity is a very high "Q" circuit and samples RF power going through the cavity's waveguide section. You will need some form of RF detector to observe relative RF power. Then notice the RF power level, spin the cavity, and when a slight dip is observed, this is your frequency. The cavity is absorbing some power when it is adjusted to your frequency; this mode is referred to as a "suck out" or "absorption" type of wavemeter.

The dip in power is sharp, and it's a slight dip, so adjust the wavemeter slowly for best accuracy. The meter amplifier is coupled to a detector on the waveguide output, allowing greater sensitivity to sample measurements being taken rather than direct connections to your system. A small horn antenna should be used on the input to the wavemeter, completing the package for the frequency meter and its wavemeter. See **Fig. 1** for the block diagram of how to connect these component parts for the monitor antenna, wavemeter/detector, and meter amplifier.

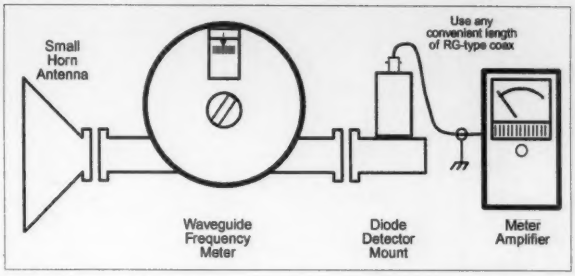


***Fig. 1.*** *Waveguide test antenna, wavemeter and meter amplifier. This setup is used to determine RF frequency, using a small horn antenna and a variable commercial waveguide frequency meter. RF is sampled with a detector and displayed on an amplified meter for sensitive meter indications.*

This one simple meter amplifier, coupled to a commercial absorption wavemeter, is essential in locating and telling you what frequency you are operating on. The wavemeter coupled with a meter amplifier, affording higher sensitivity, allows you to make frequency measurements close to your antenna vs. a direct connection.

The circuit for this amplifier is a single voltage supply (9-volt) portable radio battery powering a single CA-3130 op-amp amplifier. Do not use a substitute for

***Photo A.*** *WB6IGP operating 10 GHz WBFM on top of Mt. Soledad in San Diego. The spike on top of the dish is a 2 meter ground plane antenna for 10 GHz contact coordination.*

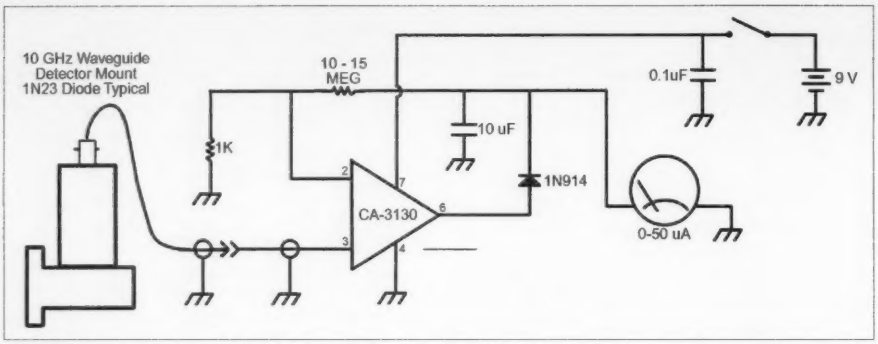


*Fig. 2. Schematic diagram for the wavemeter amplifier that is connected to the microwave waveguide detector. This circuit operates on a single 9-volt transistor radio battery for simplicity.*

the CA-3130, as others will not work in this circuit. The CA-3130 is made to work with a single supply voltage and ground, unlike other op amps. See **Fig. 2** for the necessary schematic diagram.

### System sensitivity improvements

A simple circuit using a simple Gunn transceiver is a circuit called the "Boomerang." What it does is essentially just what its name implies; weak but detectable signals are reflected back to the source. It is not a frequency calibrator for microwave as its operation is dependent on whatever frequency IF system you use, but it does receive your transmit RF and mix it with a fixed crystal oscillator equal in frequency to your system's IF frequency. It then re-radiates this new mix product which is detectable in your receiver. This signal can be used to test system sensitivity by moving the boomerang farther away from your transceiver as system sensitivity increases.

***"It's still a sensitivity game, and this little tool is so simple to build that all you need is a waveguide detector mount, to which a small TTL 5-volt oscillator is capacitor-coupled."***

Add a dish or other directional antenna to your system, and the same Boomerang can be used to adjust antenna feeds for best gain. It also can be used to test angles of your dish or other antennas. It's still a sensitivity game, and this little tool is so simple to build that all you need is a waveguide detector mount, to which a small TTL 5-volt oscillator is capacitor-coupled. Any oscillator operating at your IF frequency will work here, be it a ready-to-go TTL type or a home-brewed device. In either case, it is coupled to the detector mount and antenna attached to the Boomerang.

If your IF system is 30 MHz, use a 30 MHz crystal and set it to the same frequency at which your 30 MHz IF is set. If you are using the 88 MHz FM radio as an IF amplifier, select a crystal to match the IF frequency you select (i.e. 88.123 MHz). That's all there is to it. Power in the oscillator is not important—just a single transistor oscillator circuit will do. See **Fig. 3** for circuit information.

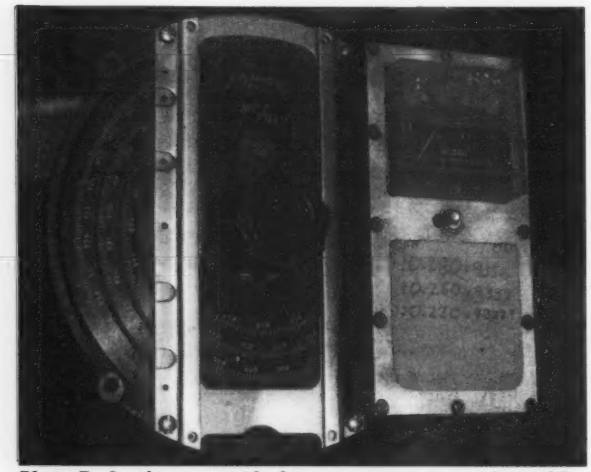

***Photo B.** Surplus waveguide frequency wavemeter with amplifier and meter indicator attached. The unit had calibration readings noted for 10.220, 10.250, and 10.280 GHz. It was very useful when using simple Solfan or burglar alarm type Gunn oscillators for WBFM.*

### Grid square program

Our microwave group has a grid square program written in BASIC that should run on most any PC. It will give you compass direction to and from distant stations, once data with grid square or latitude and longitude information is input. The program is a bonanza, eliminating guesswork with map coordinates converted to grid squares, which is often needed for contest operation. The program runs in the Chevy manual mode. For the latest input to this program for Caddy drivers, GPS (Global Positioning Satellites) are used; the exact-position data is loaded into the computer's RS-232 input port and loaded into a modified BASIC program. Additionally, a very small interface terminal has been built by Jay Goldberg, to take the data directly from the GPS receiver and display universal time and latitude/longitude data to a small 20-character plasma display. This display could be mounted on the dash of a car for portable pinpoint accuracy on location.

Well, there you have most of the insights into microwave operation, and some options on how to set up a small inexpensive station. These trails, laid out for you, were exactly the same beginning steps that many of us took, myself included, in years past. Yes, we still have our WBFM equipment, but we have grown into much more complex and costly equipment in the pursuit for better devices and systems. I strongly urge you to try WBFM as a beginning test vehicle; it's inexpensive and will give you some experience in the microwave realm.

### 10 GHz—the next generation

When you're ready for improved circuitry, high stability systems, GaAsFET amplifiers, and synthesizer frequency control to 100 Hz at 10 GHz, let me know. We have kits available, derived from commercial material, that require modification of a microstripline PC board. After modification, these units assemble into a very high-quality SSB linear system with 1 watt of output power and a receive noise figure of 1.5 dB on 10 GHz for a full-figured configuration. The basic system is contained on a single PC board (4-1/2" x 5-1/2" x 1/2" high). All circuitry is on the board, including mixers for 10 GHz. Prices start at $100 for a basic kit, plus shipping and CA tax (for CA residents only), and are available from the author, me, at the address above.

Other microwave systems have been constructed using components that were found in the

surplus market. It's amazing what can be lashed together to make a microwave converter. As an example, the above kit for 10 GHz sounds quite hi-tech. Well, for frequencies lower than 10 GHz, the gizmos needed are not as fancy or as expensive. As frequency decreases further, more and more components can be brought into play to construct a simple microwave converter.

What microwave piece parts do you look for when trying to gather material for lower frequency bands? As in any system, you need a mixer—that is a *must*. After that, you need a local oscillator to convert your IF, which could be a low-power handie-talkie on 2 meters or 450 MHz. Couple it to an amplifier with a coaxial relay to switch the circuit and you have the basic ingredients needed: mixer, local oscillator, amplifier, and relay switching.

Why venture into other amateur frequencies? In our case it started with a challenge from Kerry N6IZW: Attempt to construct a simple system for the three lower frequency microwave bands. The plan was to try and get something up and running for each of the 2304, 3456, and 5760 MHz frequency bands, one a month, for demonstration at our club/group meeting.

The requirements were not stringent, and might be nothing more than a local oscillator and mixer for each frequency in question. The intent was to promote microwave interest, along with a challenge to see what our group's members were crazy enough to assemble. The challenge was like trying to line up volunteers for a cardboard boat race. Somewhat practical, but all for fun!

If you're wondering how we achieved such a frequency-stable synthesizer, it's the main reference clock (10 MHz accurate to .01 PPM) that locks up the main synthesizer to minimize frequency errors. As I said, new toys and devices are only separated by the cost of the toys—I hesitate to mention cost as a separator between modes of operation and equipment for microwave. WBFM, as you can see, required very simple devices to make it tick. This system, on the other hand, requires an increased level of both technical skill and test equipment to make system modifications and see just what is going on. My workbench includes spectrum analyzers and microwave power meters and signal generators and sweep oscillators accurate to 18 GHz. If you venture into this realm, hopefully there will be some test equipment available to you on an individual or club basis to test your projects.

While all this equipment is not necessary, it gives you a glimpse of the increased test equipment you must have in order to modify microwave stripline circuit elements. You need some basic generators and power meters, along with technical skills, to work with these small microwave circuits—microsurgery is not for everyone and at times it's not for me. I have made my share of big blunders, primarily due to speed vs. eyesight problems with the chip component circuitry. I was able to overcome speed by just going slower and being more careful. As to the eyesight problem, I've corrected that by purchasing a dual eyepiece hood magnifier to back up my reading glasses. It really filled the bill for seeing fine details on the printed circuit boards' chip circuitry that are .050 inch square. Soldering miniature components like this can be quite demanding, trying to make a neat, orderly connection and do a good soldering job at the same time. With the magnifying hood it was not a problem.

So much for this month. Next month, I will report on the San Diego Microwave Group's progress on our quest—our energetic construction program. I will have data on the 2304 and 3456 MHz rigs that were constructed. Do not expect fancy frills or high power; these are for fun. I can't wait to see what rigs are constructed. 73 Chuck WB6IGP clhough@aol.com. 73

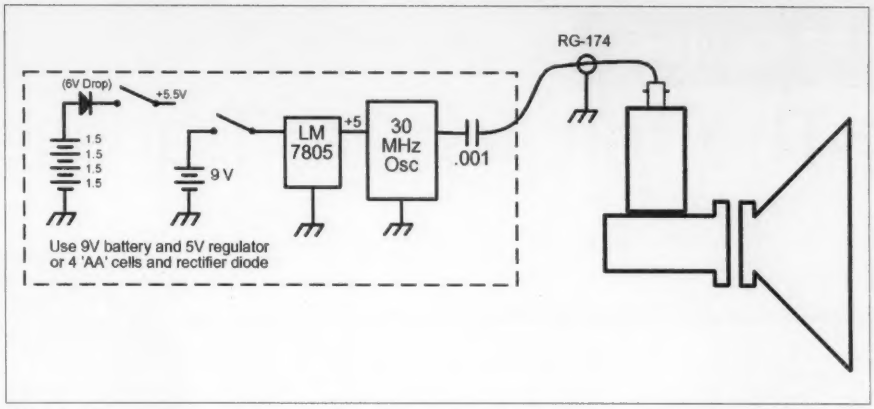


*Fig. 3. The Boomerang, or microwave reflection antenna, is a slick test accessory that helps you make relative tests to improve your system's sensitivity. It can also be used to test feed position and microwave dish aiming characteristics. The essential component is the 30 MHz TTL oscillator and a waveguide detector mount. If other IF frequencies are being used besides 30 MHz, change the crystal frequency accordingly.*

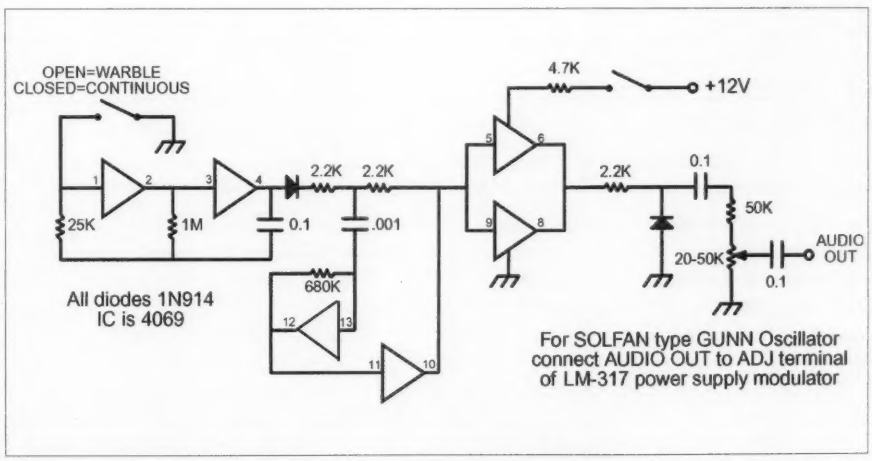


*Fig. 4. The schematic of the twiddle tone generator. This unit produces a distinctive tone that skips between two different frequencies, producing a tone pattern, allowing an easier search for new units to communicate with. It's our equivalent of a simple beacon-like tone identification accessory.*

**73 Review**

# The Ten-Tec 2m Transceiver Kit

*Have a ball building this great little $200 rig.*

Jeff Gold AC4HF
1751 Dry Creek Road
Cookeville TN 38501

This time I'm really excited! With all the new no-code Techs, the most common ham buy these days is a 2 meter transceiver. Since I have always enjoyed operating radios that I have built myself, the Ten-Tec T-Kit #1220 looked like just the ticket. Besides, while building, I am also learning how the equipment works, so I'm more likely to be able to repair it.

Ten-Tec is filling the void Heathkit left when they quit. They obviously put a lot of work into designing a microprocessor-controlled 2 meter rig that can be assembled, adjusted and maintained by hams with average building and soldering skills.

The rig has front-panel tuning in 5 kHz or 2.5 kHz steps. There is a six-digit sunlight-filtered LED frequency display and 15 programmable memories. There is also provision for five non-standard offsets and a built-in CTCSS tone generator. The transmit-receive switching is done with diodes. The rig uses a standard five-pin DIN packet connector and circuitry. There is a built-in speaker, as well as an external speaker jack. You can switch between two power levels from the front panel. Without the optional 1222 amplifier kit you will get about 1 or 5 watts, and with the amplifier, it's 5 or 30 watts.

Ten-Tec has you build the rig in stages. After you finish each stage you test and align it. They provide a blow-up of the part of the circuit you are working on with a schematic for that one section. Thus, if you do make an error, you know that everything that you have done before has checked out and you have only one small section to check for the problem. I was very careful, but when I finished the receiver and audio section, it didn't work. I found I had put a wrong value resistor in two places. I enjoyed their approach since I didn't have to wait until I finished the whole project to know that the sections were working.

The first section you build is the display driver and microprocessor circuits. When you are done, you get to see it light up. Next, you build the voltage-controlled oscillator (VCO) and phase-locked loop (PLL) circuits. Then you align the VCO using a standard voltmeter to adjust a test point for a given voltage. Then you need only check for a voltage change as you tune from one end of the band to the other. There is an optional test if you have some way of generating a 10.7 MHz signal to verify the receiver operation. The third section is the FM receiver and audio section, where you get to hook up the speaker and test the audio and squelch.

***"When you are done, this unit looks like a small commercial mobile rig, not like a kit you have built."***

Next you build the receiver RF amplifier and mixer. Then you adjust several coils for maximum voltage and one transformer for best voice quality. You now have a working receiver, so you can start listening to the local repeaters. The memories are now functional, as are the repeater offsets.

The fifth section has you building the transmit audio, push-to-talk (PTT) and frequency modulation of the VCO. When you complete this you can transmit. Boy, is that a good feeling! Now you are close to having a working transceiver.

Next you build the CTCSS tone and packet circuits; there are no alignments or tests for this section. You proceed to the transmit RF section and then to the final assembly and testing. At this point, you can either choose to have an operational 5 watt transceiver or add the optional amplifier. Either way, Ten-Tec suggests that you test out the transceiver at the lower power before installing the amplifier. If you know you are going to install the amplifier, you'll need to substitute two heavier duty diodes while building the main unit. This will save some desoldering later.

I tuned the rig to one of the local 2 meter repeaters and gave a call. The chap who came back to me reported that the rig had a good natural-sounding voice quality and I was into the repeater full quieting, even with the rig on the 1 watt power setting. He reported no difference in either the audio or my signal quality on low power. I still get excited when a new piece of gear I've built works right.

**The kit**

This is a high quality kit in every way. The printed circuit board is plated through, solder-masked, and nicely silk-screened. The plated-through part really helps in making the connections sturdier so that the assembled rig lasts longer.

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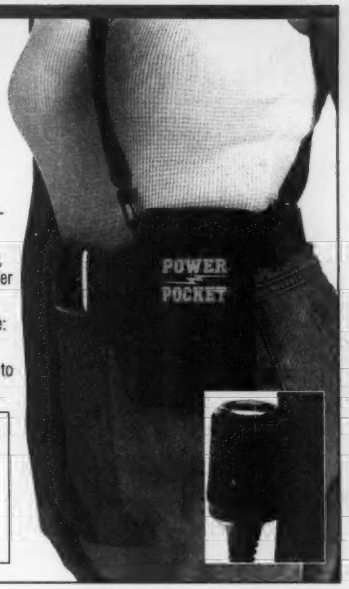


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CIRCLE 259 ON READER SERVICE CARD

The kit is complete, with all components, boards, hardware, and case. A microphone is included; however, it doesn't have a DTMF pad, so you need a separate pad to use an autopatch. Or you can use one of those "Pocket Tone Dialers" sold by Radio Shack™—a DTMF keypad that you place over your mike. It is designed to produce tones for systems (phone) that have no DTMF capability. Their least expensive one (43-145) is $17 and the next one up (43-146) with 33 memories lists for $25.

Most of the coils are pre-wound. Those that aren't are very simple to wind and there are clear instructions on how to do that. The case is very nice looking. When you are done, it looks like a small commercial mobile rig, not like a kit you have built.

I found the manual outstanding. It's very thorough, but doesn't include page after page of pointless details. The kit went together very easily for me. The few minor problems I had were my own fault. If you run into a problem while building the kit and call for help, you might very well discover that you're talking to the person who designed the rig.

***"This kit makes it possible for even a no-code Tech to have the fun of building a transceiver and the pride of operating something they've built."***

This kit makes it possible for even a no-code Tech to have the fun of building a transceiver and the pride of operating something they've built.

The completed transceiver works great! It's easy to program and use. Even without the optional amplifier, you should have no problem getting in full quieting to most local repeaters. I have had no trouble getting into any of the five local repeaters on low power without the optional amplifier. For more distant repeaters, you might want to go for the optional amplifier. If you build the amplifier later you add a very simple board onto a big heat sink, desolder two diodes from the main board, and put in a jumper. The s amplifier board fits on a heat sink which attaches to the back of the rig.

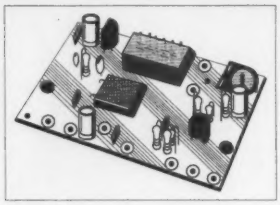
It doesn't take much of a power supply to run the rig. 13.5 VDC at 1A on low power and 5A on high power. The completed unit weighs only 2-1/2 pounds (and that's with the amplifier added), so you can even take it along on camping trips.

$195 for a kit of this quality is a real bargain. Who says amateur radio is an expensive hobby? I recommend the Ten-Tec T-Kit #1220 highly.

For more information contact Ten-Tec at 1185 Dolly Parton Parkway, Sevierville TN 37862-3710. Or call their information line at 423-453-7172.

# New Products

*Number 72 on your Feedback card*

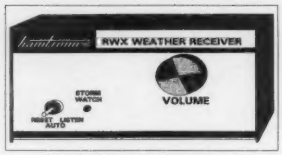


## New CTCSS Encoder/Decoder Module

Hamtronics has a new version of their long-popular Subaudible Tone Encoder/Decoder module. The new TD-5 has several new features, including crystal control for precise tone accuracy and a convenient DIP switch for tone selection without test equipment.

The TD-5 will let you use your existing FM transceiver to access all your favorite closed repeaters. The thorough manual shows you all you need to know about encoding and switching and selecting tones, and helps you install the module in any transceiver. If you need a receiver decoder, the same TD-5 can be used to mute receive audio unless the proper tone is present on the signal. A convenient control line can be used to unmute the receiver manually to allow monitoring, and a high-pass filter gets rid of annoying tone buzz in the speaker audio.

And it's only $39—what a deal! That's the kit price, of course, but it's only $59 factory-wired and tested. For more details, write to Hamtronics, Inc., 65-D Moul Rd., Hilton NY 14468-9535; call (716) 392-9430 or FAX (716) 392-9420. While you're at it, ask for their complete catalog, and please tell them where you saw this announcement.




## Professional-Quality Weather Alert Receiver

The new RWX Receiver from Hamtronics, Inc., the leading supplier of narrow-band FM receiver and transmitter modules for hams, is just what you need for demanding applications. Airports, police and fire departments, CAP, rescue crews, broadcast stations, amateur repeaters, local emergency managers—anyone who needs up-to-date weather information and emergency warnings—can depend on the RWX Receiver. Because of its reasonable price, it's also handy for bikers, hikers, boaters, farmers, hunters...well, who *couldn't* sometimes use an automatic "Storm Watch" alert? That's only one of the RWX Receiver's many features.

The RWX Receiver is small enough for emergency or portable use, and can be powered by a 9-12V battery when needed. It's crystal-controlled for accuracy, and all seven channels are provided, including the new split channels.

For economy, get the PCB module in kit form for only $79. With Hamtronics' thorough instruction manual, you'll find it easy to build and align. You can also buy the kit with a cabinet, AC power supply, and built-in speaker for only $99. And if you decide to take the easier route, the unit is available factory-wired and tested with an attractive metal cabinet, speaker, and power supply, for $139.

For more details, write to Hamtronics, Inc., 65-D Moul Rd., Hilton NY 14468-9535, or call (716) 392-9430. Ask for a data sheet on the new RWX Receiver. While you're at it, let them know where you read this announcement.

## HamCall CD-ROM

Buckmaster's HamCall CD-ROM April 1996 edition is now available, from Buckmaster or your dealer. Get complete US and extensive international listings—over 1,290,000 callsigns, including clubs, military, and RACES listings, with more than 110,000 cross-references from old to new calls. You'll have all the data you need right there in front of you, and you can print lists and labels, edit records, even look at photos of many hams. Photos/QSLs appear automatically in Windows©, with the touch of a button in DOS. Your photo or QSL can appear in the next update, free! Find out more by contacting Buckmaster, 6196 Jefferson Highway, Mineral VA 23117; Phone (540) 894-5777 or (800) 282-5628; FAX (540) 894-9141; E-mail at info@buck.com.

## Low-Cost Boom Microphone Headset Kit

The new Model TR-2000 is specifically designed for amateur radio applications, and features a noise-canceling electret microphone with a "tailored" frequency response. The flexible microphone boom is spring-loaded to provide a mechanical memory for the user's adjustment. Received signals through the moving-coil ear speakers are crystal clear. The large plush earmuffs aren't just comfortable; they add to the noise-canceling feature, allowing good performance even under high-background noise conditions.

The Model TR-2000 is compatible with the majority of contemporary radios—fixed station, mobile, hand-held, HF, VHF, and UHF, as well as many vintage rigs.

The Model TR-2000 is an easy-to-assemble kit with step-by-step instructions for $44.95, or assembled and tested (without connectors) for $64.95. Both options are available with a 30-day, money-back guarantee from Warren Gregoire & Associates, 229 El Pueblo Place, Clayton CA 94517. For additional information, call (800) 634-0094 or (510) 673-9393.

### CABLE X-PERTS, INC.'s New Catalog Is Invaluable!

If you're replacing or adding cable of any kind at your station, or just getting started, you'll find this new catalog essential. It's a complete listing of cables, technical information, prices, and now detailed pictures and connector installation instructions. All this, and more, for a business-size SASE sent to: CABLE X-PERTS, INC., 416 Diens Dr., Wheeling IL 60090.

## RF Applications Digital Wattmeter

A *digital* wattmeter? The P-2000A is a digitally-driven analog meter that indicates peak RF power and VSWR. This little $299 baby automatically selects the 200- or 2000-watt range for you. It has an SWR alarm which you can set to trigger when it goes over a certain SWR. Write RF Applications, 9310 Little Mountain Rd., Mentor OH 44060, or call 800-423-7252 for even more reasons to buy it.

**Alchemy Today** by Chris Illert. Subtitled: A beginner's guide to Hadronic circuit diagrams and secrets of cold nuclear fusion. This large 172-page archival quality (very heavy paper) book is a lavishly illustrated introduction to the latest concepts in atomic physics. Well, atoms are made up of electrons, protons, and neutrons. And they're made up of quarks. And quarks are made up of omegons. And what are omegons made of? Strings of Green Energy Balls, as originally describedby Bessant and Leadbeater in 1895. Aha, so what is "energy?" Never mind, just get the book and catch up with the weird places theoretical physics has gone in the last few years. Warning: this book is not easy going. However, if you're interested in learning about how cold fusion works, this book is a fine primer. $60.00. From Radio Bookshop. (Order form on page 88.)

# Kit Building Is Fun...And Saves Money

A kit building tradition started with the dawn of ham radio in the 1920s, peaked in the 1960s and nearly vanished when HEATHKIT™ discontinued ham products in the 1980s. Many of you continue to encourage us to revive the tradition.

The T-Kit division of TEN-TEC is dedicated to putting the fun back into building. Our pledge is to design kits from the ground up to be built by average hams with simple test equipment. And best of all, kit building saves you money...20, 30 even 40% over comparable factory built gear. Have some fun and build your next project!

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- Build it now 5 or 30 watts, or upgrade to 30 watts later
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## 6 METER FM TRANSCEIVER

Same features as 2 meter model. Covers 51.095-54.1 MHz.
1260.....5 watts out.....$195*
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No need to buy a complete transceiver to discover the fun of 6 meters. T-Kit offers two transverters to choose from. **Model 1209** converts your 2 meter handheld or mobile rig to 6. All features and modes on your 2 meter rig immediately available on 6 (FM SSB CW). Tune 144-148 MHz to work 50-54 MHz. **Model 1208** converts any modern HF rig with 20 meters to 6. Tune 14-14.35 MHz to work 50-50.35 MHz.

- 5 watts max input delivers 8 watts out
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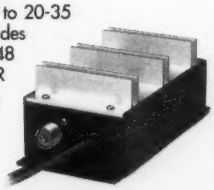

1200 .....kit.....$74*
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Connectors for both HF and VHF let you leave meter in line with BOTH rigs. Front panel switch between HF and 2 meters. Measure power or SWR on 20 or 200 watt ranges. 1.8-30 MHz and 144-148 MHz.

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Annoying RFI/TVI and hot chassis problems are often caused by lack of proper ground. While not a substitute for radials or good grounding, Model 1251 provides "tuned counterpoise" to satisfy the transmitter.
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Modernized "first radio kit" classic. 5 transistor, 3 IC design, electronic bandswitch. Tune both AM broadcast and SSB/CW from 1.8-22 MHz. Has Main and Fine tuning, Regen, RF gain, Volume. Powerful audio to built-in speaker, your own speaker or stereo phones. Use 8 C cells or ext. 12 VDC.
1253.....$59*

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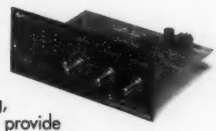
This Regen beats the pants off those favorite 3-tube radios of the 1950s. Covers 49 and 31 meter SW bands, 40 and 20 meter ham bands plus 12-15 MHz. Includes front panel. Dress it up with your own case and knobs. Push button bandswitch, Main Tuning, Regen control, volume, on-off switch. You provide DC, stereo phones or speakers. Popular group project!



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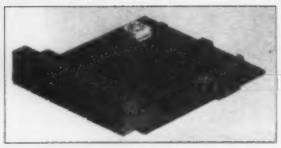
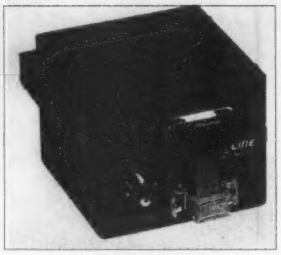


**Optional Module for Skyline-RTU**



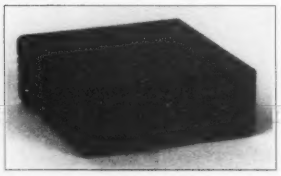
**Skyline-RTU**

## Skyline-RTU with a No-Cost Repeater Option

Does it get any better than this? RF Neulink is now shipping its Skyline-RTUs with a no-cost repeater option; the repeater function is implemented via the serial port. Each RTU is a fully integrated subsystem that includes a UHF transceiver, RS-232 modem interface, and a digital/analog I/O board. The standard device provides for eight optoisolated digital inputs/outputs, and two analog-to-digital converter terminals. The I/O modules are stackable up to eight units, providing a combination of up to 64 digital I/O and 16 A/D terminals. Optional RTU modules are available with eight channels in and out, and four channel relay output ports.

The radio modem platform is the Neulink 9600, a high-speed, 9.6 Kbps, 2 watt transceiver modem. Up to 64 RF channels can be programmed into internal memory. Additional features are 16-bit CRC error detection, RTS/CTS, XON/XOFF, or no flow control. With its 65,000 unique ID codes, this synthesized UHF modem can be configured for point-to-point and point-to-multipoint networks.

For more information, contact RF Industries, Neulink Division, 7610 Miramar Rd., San Diego CA 92126; phone (619) 549-6340.



## Versatile New Telephone Interconnect

Communications Electronics Specialties has released the first in a new series of telephone interconnect devices that will allow land mobile radio users easy access to the telephone network. The new simplex and semi-duplex 4700VP can be easily installed into nearly every repeater/transceiver on the market; it has an automatic setup feature and can be programmed locally or over the air.

The 4700VP is the lowest cost, smallest size unit on the market, but it's loaded with features like 25 speed-dial locations, 10-digit connect/disconnect code, pulse or tone dial, lightning protection, full-feature toll restriction with inclusion and exclusion numbers, built-in audio path and last number redial. For more information, telephone CES at (407) 679-9440, FAX them at (407) 679-8110, or write to: 925-122 S. Semoran Blvd., Winter Park FL 32792.

**Final Quantum Revelation** by Kiril Chukanov. Subtitled: General theory of world organization. This 400 page book is also lavishly illustrated. It is also tough going at times (lots of equations), but it covers an amazing range of topics. Ball lightning as a potential source of power, cold fusion power, etc. Chukanov got his information via a series of revelations from a supermind, but you'll see that he's backed up his theories with good solid lab work. He covers the fundamental laws, elementary particles, chemical elements, quantum boundaries of the world, the solar system, the galaxy. $35.00 from Radio Bookshop. (Order form on page 88.)

## QSL Contest

Did you buy your QSL off a rack, or did you put some thought and creativity into it? If you think you have a winner, send it in and let us have a look at it. Who knows, it might make the cover. Well, maybe page 85 or so. Or maybe Wayne's wastebasket. If it's declared a winner, you'll get a CD of your choice of any of 26 kinds of music, as listed in Wayne's November editorial. You'll also see it in 73!
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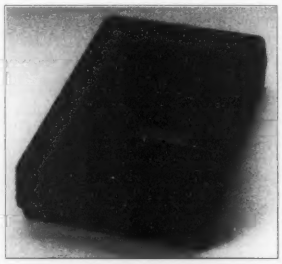

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PowerAlert Plus is the only power management software available on CD-ROM covering so many systems on a single disk. It's available separately for $89 or bundled with Tripp Lite's SmartPro UPS systems. For more information, call (312) 755-5401; FAX (312) 644-6505; E-mail: info%tripplite@mcimail.com; or at web site http://tripplite.com.

# CARR'S CORNER

## Analog-to-Digital (A/D) Converters

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

### Some things you oughta have

When we think of ham radio stuff we normally think of a shiny new SSB transceiver with digital readout, digital signal processing, a pan adapter oscilloscope to check for gaps in the band where one might set down and call "CQ," all of which costs more than I paid for my first new car (of course, it's relative—I paid about the same for that car as my father paid for his first house). There are, however, a number of things that are handy to have around the ham shack. Let's take a look at a few of them.

### Dummy loads

The dummy load, or artificial aerial as it is called in the UK, is a resistor used to simulate an antenna when adjusting a transmitter or other radio apparatus. These devices consist of a noninductive 50-ohm resistor inside a shielded enclosure.

The dummy load offers a couple of benefits over regular antennas. First, it is a nearly constant impedance over the entire frequency range, and, second, it does not present any appreciable reactance. Third, and perhaps most important, the dummy load provides the ability to conduct tests off the air where you won't cause TVI, BCI, or interference to other users of the test frequency that you select. Besides, it is illegal and just plain rude to radiate when you don't have to!

One use for dummy loads is to adjust antenna tuners. You can connect the dummy load to the antenna output of the tuner, and then adjust the controls for best VSWR at a number of frequencies. By recording the knob settings, you can "rough in" the antenna tuner when changing frequency.

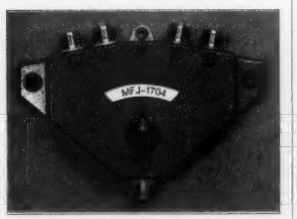


***Photo A.** Coaxial switch.*

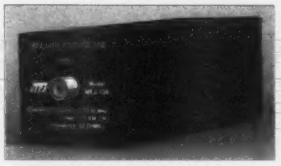

***Photo B.** Low-pass filter*

### Coaxial switches

A coaxial switch (**Photo A**) is used to allow a receiver or ham radio set to use any of several antennas (up to 16-port models are available, but this one is a four-port model). The common connector is for the receiver or transmitter, while the antennas and/or dummy loads are connected to the "A," "B," "D," and "E" ports, respectively; the "C" port is for the coax line to the rig. Alternatively, one can turn the switch around backwards (it's bidirectional, after all), and use the same antenna on two different receivers or transmitters.

The use of the coaxial switch in antenna measurement is in comparing the antenna being tested with either another antenna or a dummy load. The kind of off-the-air checks that amateurs can make are notoriously inaccurate, but can be made a lot more useful by making comparisons with known antennas. For example, a friend of mine, the late Johnnie H. Thorne K4NFU/5, had an antenna farm in Texas (and it did seem that he grew antennas, judging from the number he had). He kept a standard dipole, optimally installed and cut for 20 meters, and made all of his test designs for the same frequency. He would compare new designs to the dipole by switching back and forth while monitoring the signal strength on the receiver's S-meter. He could also compare two different antennas by comparing them against each other or against the dipole. Not perfect, and anyone with a professional antenna range would sneer, but it worked for ham purposes.

***Photo C.** Digital frequency counter.*

### Low-pass filter

A low-pass filter (**Photo B**) is a frequency selective device that passes frequencies below the cutoff frequency, and attenuates frequencies above that point. So why do we need a low-pass filter? Because all transmitters produce harmonics, i.e., signal at frequencies that are integer multiples of the fundamental frequencies (14 MHz is the second harmonic of 7 MHz, while 21 MHz is its third harmonic, etc.). Although there are legal specifications of how little harmonic energy you are allowed to produce, and we would like to radiate zero power at the harmonic, all real transmitters produce some harmonics. The problem gets worse when the antenna is resonant on the harmonic or the transmitter is either improperly adjusted or defective.

The main purpose of the low-pass filter is to prevent harmonic energy from HF ham transmitters from clobbering television reception. The typical ham low-pass filter has a cutoff frequency at some point above the 10 meter ham band, but below TV channel 2. If a harmonic is produced by the transmitter, then it will be attenuated by the low-pass filter before it does any damage.

### Digital frequency counter

At one time, digital frequency counters (DFC) were terribly expensive. Even "cheap" models cost about the same as new cars of that era, and they were heavy, as well as power hogs. Those DFCs were really open only to professionals and that top elite of rich hams. The rest of us used a receiver and crystal calibrator to measure frequency, more or less (although I've seen some pretty good results using cheapo equipment during the old ARRL Frequency Measurement Tests).

Today, the situation is different. While the best DFCs are still costly, there are a number of ham-grade instruments on the market (**Photo C**) that are very reasonably priced, and will allow you to measure frequency accurately enough for most ham uses. These battery-powered devices make the use of the DFC a game for all.

### Doing DC

One of the aggravating things about my ham shack, as well as my computer desk, is the ugly wall-warts hanging out of every available 120 VAC outlet. Every accessory that you buy these days seems to be powered by a wall-wart transformer, and there just simply isn't space for all those power modules. **Photo D** shows a DC power strip. A single DC power supply is input to one end, then up to seven devices can be plugged into the DC outlets. A DC voltmeter on the strip reads the value of the applied voltage.

### Connections ...

I can be reached via snail mail at the address above, or via Internet E-mail at carrjj@aol.com.

Photos for this column were supplied by MFJ Enterprises, Inc., P.O. Box 494, Mississippi State, MS 39762. 73

***Photo D.** DC outlet strip.*

# HAMSATS

## Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

A key part of every satellite station is the antenna system. While small, simple antennas are great for experiments and portable use, they make most contacts via satellite difficult and less enjoyable. The end result is fewer contacts, less fun, and eventually disinterest in this exciting facet of amateur radio.

Most newcomers to OSCAR (Orbiting Satellite Carrying Amateur Radio) start on the analog LEO (Low Earth Orbit) hamsats, like RS-10 and RS-12, using simple antennas. Successful enthusiasts study the deficiencies of their systems and make corrections. With some experience, they eventually go on the digital satellites like KITSAT-OSCAR-23 and 25, and the high-orbit hamsats like AMSAT-OSCAR-10 and 13. The others go back to HF and local repeaters.

### Successful LEO antennas

Most ham stations already have sufficient antennas to get started with LEO satellite work. Almost any antenna cut for 10 meters will receive RS-10. A dipole or inverted-V with a reasonable coax run and a sensitive receiver will do the job. For many this will be their final receive configuration, providing effective results for hundreds or even thousands of satisfying contacts.

Improvements require experimentation and will be location-dependent. Antennas that work include horizontal loops, verticals, turnstiles, eggbeaters and yagis. Due to the different radiation patterns of these antennas, some perform better than others during a given satellite pass. The vertical and the yagi may do well for DX contacts when the satellite is on the horizon, while the dipole or turnstile will have better reception when the satellite is overhead. One option is to have two or three different 10 meter antennas hooked to a coax switch in the shack. When reception on one antenna is bad, try a different one.

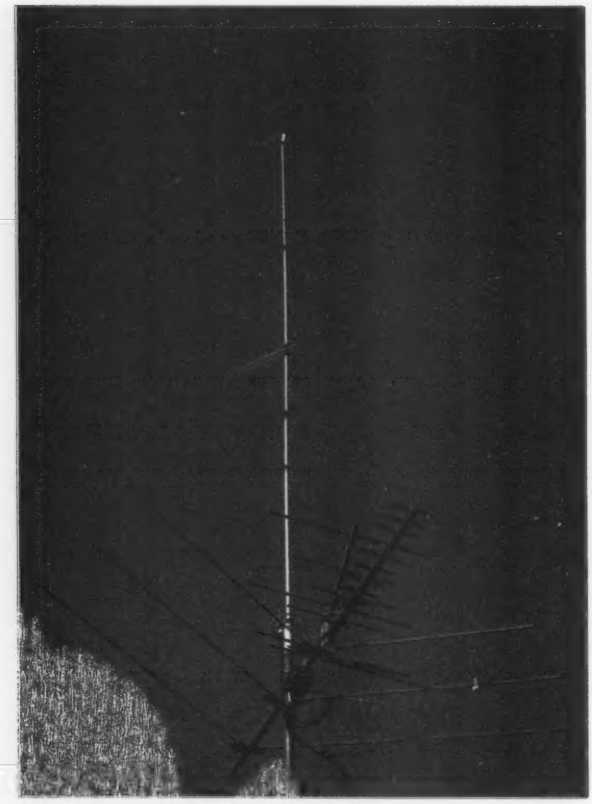

*Photo A. A vertical mounted above the TV antenna does a great job for the RS-10 uplink on 2 meters.*

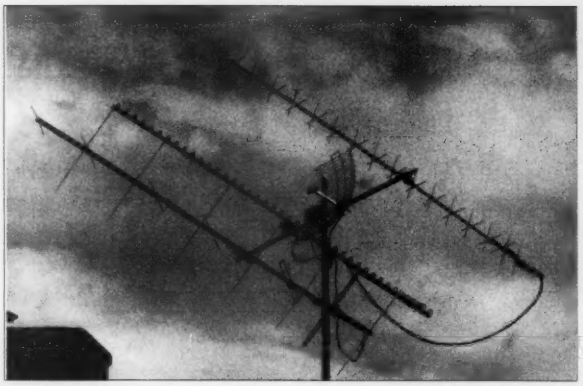

***Photo B.** An array of antennas for A-O-10 and 13 work at WA5ZIB includes (from left to right) a KLM 2M-14C for 2 meters, a Down East 45-element loop yagi for 23 cm, a Bob Myers dish for 23 cm and a Hy-Gain 215SAT for 70 cm, all on a nine-foot Fiberglas™ boom.*

***"Getting a 2 meter signal up to RS-10 is almost as easy as receiving signals from the satellite."***

Getting a 2 meter signal up to RS-10 is almost as easy as receiving signals from the satellite. Almost any omnidirectional vertical antenna in the clear will work with a 25-watt transmitter. While there are several commercial antennas to choose from, others, like ground planes and J-poles, are easy to build. For the 15 meter uplink of RS-12, a dipole with a 25- to 100-watt transmitter will do the job.

### Antennas for the high-orbit hamsats

While most LEO satellites have altitudes of 1,000 miles or less, the high-orbit DX satellites like A-O-10 and 13 have apogees or high points out to 24,000 miles. The signals from these satellites are much weaker. Better antennas are needed to make reliable contacts.

The current high-orbit satellites use frequencies in the 2 meter, 70 cm and 13 cm bands. After the launch of Phase 3-D, later this year or early next year, we will have a satellite spanning ham bands from HF up through 24 GHz. The bands covered by A-O-10 and 13 will be very popular on P3D, and provide future P3D users with an opportunity to get ready for the new satellite by getting systems running now. Signals from P3D are expected to be at least 8 dB better than the signals from A-O-13, but not for all passes. Setting up an antenna system for reliable activity through the current satellites will insure great operation through P3D.

VHF and UHF satellite antennas don't need to be up high, they just need to "see" the sky. It's best to have an unobstructed view of the horizon in all directions. Trees and buildings attenuate both received and transmitted signals. Commonly used antennas for 2 meters and 70 cm are circularly-polarized commercially-built crossed yagis. Manufacturers include Hy-Gain, M-Squared, KLM, Tonna and others. The first four brands are the easiest to find.

One package includes a 20-element 2 meter crossed yagi, a 16-element 70 cm crossed yagi, and a mounting boom with mounting plate suitable for use with the

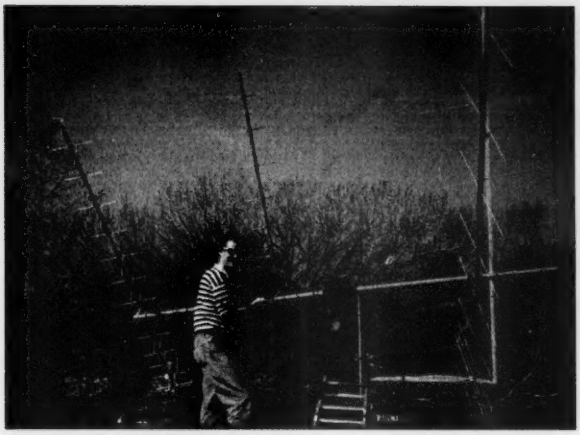

***Photo C.** Bruce KK5DO doing some maintenance on his rotator system. The antennas include an M-Squared 2MCP22 for 2 meters and a pair of 436CP30s for 70 cm.*

Alliance U100 rotor (used for elevation control). It does not come with polarization switching, but it is the least expensive. The cable harness typically is set for RHCP (right-hand circular polarization) to conform with most satellites. The individual antennas, cross boom and mounting plate can be purchased separately, if necessary. A polarity switcher is available for the 70 cm antenna, and a 10-element 2 meter crossed yagi is an alternative for those with space constraints. The smaller antenna exhibits less gain.

The OSCAR Link antenna system from Hy-Gain offers advantages over other systems, but costs a little more. It includes a 16-element 2 meter crossed yagi, a 30-element 70 cm crossed yagi and a heavy-walled Fiberglas™ cross boom. The hardware is stainless steel with ultraviolet stabilized plastic insulators. Many other items have been carefully engineered, including polarization switching relays rated at 200 watts. For a cost-effective system with excellent performance, this antenna array is the best choice.

A newer company called M-Squared sells several types of satellite antennas. The most popular models for effective communications through A-O-10 and 13 are the 2MCP14 and 436CP30, for 2 meters and 70 cm respectively. The 2MCP14 has 14 elements and a 10-foot boom, and matches well with the 30-element 436CP30. M- Squared also has longer versions of these antennas, and omnidirectional eggbeater antennas for both bands. Quality components are used throughout. Many satellite enthusiasts have had excellent results with M-Squared products.

The finest, and also the most expensive, antennas are made by KLM. Two versions of the 2 meter crossed yagi are available. One has 14 elements and the other has 22. Just the 2M-22C (22-element antenna) includes switcher and stainless hardware. For 70 cm, there is either an 18-element or 40-element antenna.

### More information

If you would prefer to build your own antennas, or to study the topic of antennas for space communications, consult *The ARRL Handbook, The ARRL Operating Manual, The Satellite Experimenter's Handbook,* many AMSAT publications, and the AMSAT HF and satellite nets.

Many discussions on the Internet through amsat-bb@amsat.org have approached the topic of effective antennas. To subscribe to amsat-bb, send a message to listserv@amsat.org. In the body of the message, simply type "subscribe amsat-bb." The system is not automatic, so it may be a few days before the mail starts coming through. 73


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Ham Radio Fun

# Communications Simplified, Part 8

*The secret world of FM.*

Peter A. Stark K2OAW
PO Box 209
Mt. Kisco NY 10549

Last time we looked at AM radio; now it's time to get a bit more complicated and tackle FM, or frequency modulation.

Today, there are very few AM-only or FM-only radios made; most radios cover both AM and FM broadcast bands. So most of us listen to both AM and FM broadcast stations. Unfortunately, this often leads us to the wrong conclusions about their relative features.

AM broadcast station carrier frequencies are in the range from 0.55 to 1.6 MHz, and are limited to 20 kHz bandwidth. On the other hand, FM broadcast carriers lie between 88 and 108 MHz, and are assigned 200 MHz bandwidth. AM signals travel farther because of the lower frequencies, and FM signals can be heard better in underpasses and tunnels because of the higher frequencies. If AM was allowed wider bandwidths, it too could have a better frequency response. The major advantage that FM has over AM is that it resists noise and interference better.

***"The major advantage that FM has over AM is that it resists noise and interference better."***

Most people know that FM sounds better—it has better frequency response and less noise and interference, and can be heard in underpasses and tunnels, where AM fades out. They also know that you can hear AM broadcast stations farther away than FM stations, especially at night. They become convinced that these characteristics are true for all AM and FM. In reality, much of what we think about FM comes not because it is FM, but because commercial FM radio stations use different carrier frequencies from AM stations (VHF instead of LF), and they are allowed to use wider bandwidths.

## Frequency Modulation (FM)

Just as amplitude modulation changes the amplitude of a carrier, frequency modulation changes the frequency of the carrier. There is also phase modulation which–you guessed it–changes the phase; we will discuss it later in this part.

**Fig. 1** shows what we mean by FM. At the top, we see the audio waveform that we want to transmit (although we're talking about sending audio at this point, in reality you could send video, data, or any other kind of information via FM). In the middle is the carrier, as it would look before modulation. At the bottom is the resulting FM wave. As you can see, the frequency goes up (cycles are closer together) when the audio wave is high, and the frequency goes down (cycles farther apart) when the audio wave goes down (it could also be the other way–one goes up when the other goes down).

When there is no modulation (such as when an FM broadcast station transmits silence) the carrier frequency rests at what is called the *center frequency*; if you hear an announcer say "This is WXYZ on 96.3 MHz," that tells you what the center frequency is. Once the music starts, the frequency starts to vary above and below that center frequency; we say that it is *deviating* from the center frequency. *Deviation* is the word that describes how far it deviates from the center frequency.

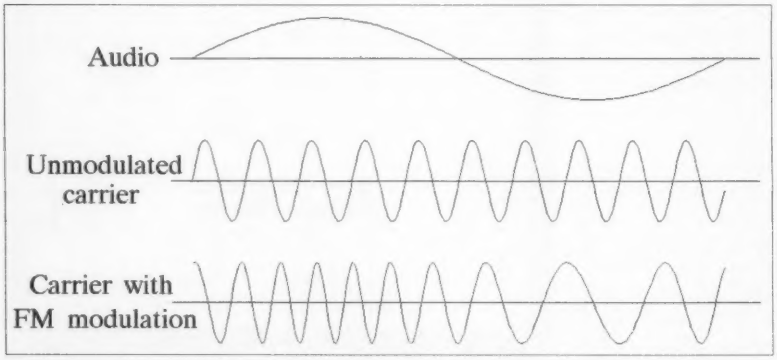


***Fig. 1.*** *Frequency modulation.*

DETOUR

Here is a short BASIC program that generates the picture in **Fig. 1**. You can experiment with it to see what happens as you change values.

```
10 'Program to generate FM
20 TWOPI=2*3.14159265
30 FAUDIO=1
40 FCARRIER=10
50 MODINDEX=5
```

```
60 SCREEN 2
70 FOR X=0 TO 639
80 T =X/640
90 AUDIO =SIN (TWOPI * FAUDIO * T)
100 CARRIER = SIN(TWOPI*FCARRIER*T)
110  FM =SIN(TWOPI*FCARRIER*T-MODINDEX*COS(TWOPI*FAUDIO*T))
120 PSET(X,50-20*AUDIO)
130 PSET(X,100-20*CARRIER)
140 PSET(X,150-20*FM)
150 NEXT X
160 IF INKEY$="" THEN GOTO 160
170 SCREEN 0
```

At 640 different values of X going across the screen, the program calculates the voltage of the *audio* signal and the *carrier* signal (whose frequencies are FAUDIO and FCARRIER, respectively), and then combines them into an FM signal. The three PSET instructions in lines 120, 130, and 140 then plot these values on the screen.

END OF DETOUR

FM differs from AM in many ways. Noise and interference usually corrupt signals by changing their voltage—by adding spikes, or in some other way changing the shape of the signal; they cannot change its frequency. Since FM signals only change their frequency, not their amplitude, it's possible to design a receiver that ignores amplitude changes (for instance, an FM radio often contains a *limiter* circuit which clips the tops off the signal to make the signal the same height no matter what level it comes in). The receiver will then ignore the noise altogether. This won't work for very weak signals, of course, since then there's nothing to clip, but for any reasonably strong signal, FM can be remarkably free of noise.

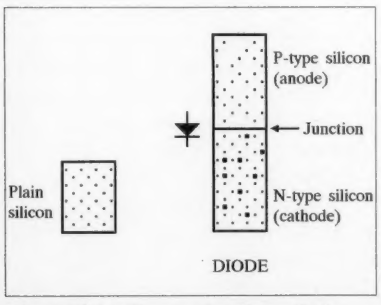


***Fig. 2.*** *Plain silicon and a silicon diode.*

**Producing FM**

There are many ways to produce an FM signal. One way is to build an oscillator and wiggle its frequency back and forth in step with the modulation signal, using a special kind of diode called a *varicap*.

DETOUR

Most semiconductor diodes are made of silicon, which is a semiconductor—it conducts electricity, but not well, because its electrons are not very free to travel, so they cannot carry any substantial current. But it can be made into a better conductor by adding other materials to it. These make it less pure, and so are called *impurities*; the resulting impure silicon is said to be *doped*.

One type of impurity has *more* conduction electrons than silicon; since electrons have a negative charge, the resulting doped silicon is called N-type. It has an excess of electrons, and the new electrons which were added by the N-type impurity are now freer to move and therefore make the silicon into a better conductor.

Another type of impurity has *fewer* conduction electrons than silicon; this produces a lack of electrons, and leaves "holes"—places where the silicon would like to have an electron, if there were any around. This sort of doped silicon is called P-type, because these holes behave sort of like positive charges.

Think of this as a game of musical chairs. In the normal musical chairs game, there is a ring of chairs and a ring of people, but there is always one fewer chair than there are people. When the music plays, the people move from chair to chair, and when the music suddenly stops, everyone sits down. Of course, there is always one person without a chair, so he is "out," and so on. Suppose we reverse the game—instead of having one chair too few, put in one chair too many. Now there is always a chair free. As people move from chair to chair, ignore the people and instead focus your eyes on whichever chair is empty at that instant. As the people are moving in one direction, the empty chair seems to be moving in the opposite direction.

P material behaves the same way, except that the electrons are like the people, and the holes are the empty chairs. As a nearby electron jumps into a hole, it leaves another hole behind it. And so it looks as though the hole moved in a direction opposite to that of the electron.

**Fig. 2** shows how this can be used to make a diode. On the left we see a piece of plain silicon. The dots show the positions of the electrons which might carry current if they were more free to move. The silicon is a crystal, and the atoms and their electrons form a neat pattern throughout the material.

On the right in **Fig. 2** we see how a semiconductor diode is made up out of two pieces of silicon. The anode is a piece of P-type silicon, while the cathode is made of N-type silicon. The place where they abut against each other is called the *junction*.

If you compare the P-type anode with the plain silicon, you will see that there are white areas where there are electrons missing; these are the holes. On the other hand, we drew some larger dots in the N-material to show the extra electrons added by the doping.

Now imagine that the diode is forward biased; that is, the anode is connected to a positive voltage, while the cathode connects to negative. Since the negative electrons are repelled by the negative voltage at the cathode, and attracted by the positive voltage at the anode, they start trying to move upward. Every now and then (quite often, actually) one of the extra electrons in the cathode will look across the junction, spot a hole on the other side, and jump into it. Of course, new electrons coming in from the negative terminal replace the lost electrons in the cathode, while the extra electrons in the anode jump from hole to hole and eventually go out the positive terminal. This gives us a current through the diode.

But now look at **Fig. 3**, which shows the diode reverse biased—that is, the anode terminal is connected to the negative terminal of a battery, while the cathode is connected to the positive terminal. Under these conditions, there is no current flow through the diode, simply because all the electrons up in the cathode are being attracted by the positive terminal of the battery, while all the holes at the bottom (which behave like positive charges) are attracted to the negative terminal of the battery.

Because all the electrons and holes are being pulled away from the junction, there is a region around the junction

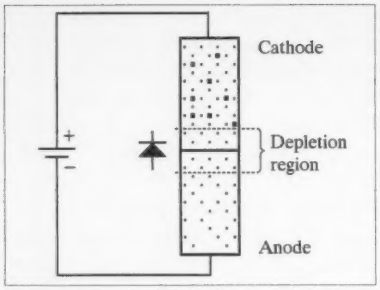


*Fig. 3. Reverse-biased diode.*

(sort of like a demilitarized zone) where there are no holes and no extra electrons. In electronics, this zone is called a *depletion region*, and you can see in **Fig. 3** that this region is just plain silicon-no extra electrons, and no holes.

The size of this depletion region depends on how much voltage there is. If the battery voltage is small, there isn't much pull on the holes and electrons, and the region is fairly thin. If the voltage is high, then the region becomes much larger. The depletion region acts like an insulator, and prevents current from flowing through the diode.

So the diode acts like a conductive region at the top, an insulator in the middle, and another conductive region at the bottom. That is the exact description of a capacitor—two conductors separated by an insulator. The diode therefore acts like a capacitor, but the capacity depends on the spacing between the conductors, which in turn depends on the applied voltage. Hence, this is a variable capacitor, or varicap.

Varicap diodes are specially made to exhibit large changes of capacitance with voltage, but all diodes exhibit this effect to some degree. For example, the common 1N4001 rectifier diode makes a dandy varicap for many purposes.

END OF DETOUR

**Now back to FM modulation**

To produce FM, we need to produce a sine wave carrier whose frequency varies with the modulation we want to put on it. One way to do this is to build an oscillator which will produce the carrier, and then vary its frequency in step with the modulation. If we use an LC circuit (a tuned circuit with an inductor L and a capacitor C) to set the frequency of the oscillator, then we can add a varicap across the LC circuit. The audio (or other modulation) is sent to the diode, changing its capacitance. This changes the resonant frequency of the tuned circuit, which, in turn, changes the oscillation frequency. Voilà—FM.

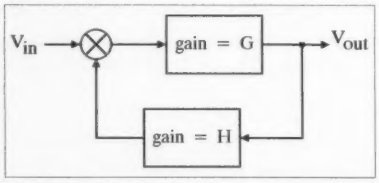


*Fig. 4. A servo loop.*

DETOUR

An oscillator is a circuit which produces an AC wave (the word *oscillate* means to swing back and forth). A typical oscillator consists of an amplifier, with part of its output sent back to the input by a *feedback* circuit.

**Fig. 4** shows a circuit sometimes called a *feedback loop* or *servo loop*. An input signal ($V_{in}$) is applied to a combiner circuit (the circle with an X inside), and then to an amplifier which has a gain G. The output from the amplifier is $V_{out}$.

A portion of $V_{out}$, however, is sent back through a box whose gain is H, and combined with the input in the combiner; the combiner is also sometimes called a *summer* or *comparator*, depending on the application.

The normal equation for the overall gain of a servo loop circuit is

$$A = \frac{V_{out}}{V_{in}} = \frac{G}{1 - GH}$$

There are two possible things that can happen at this point, depending on whether we have *negative feedback* or *positive feedback*.

(A) Negative feedback. As we can see in **Fig. 4**, the actual input into the amplifier is a combination of the input voltage ($V_{in}$), and the feedback voltage. If these two signals are out of phase, then the actual input would be less than $V_{in}$, and, therefore, the output voltage from the amplifier would be less than if there was no feedback. In other words, the gain of the servo circuit is now smaller than the gain of the amplifier all by itself.

We can see this in the above equation. If the product of G times H is negative, then the denominator of the equation is larger than 1 (since subtracting a negative number is the same as adding a positive number). Dividing G by a number larger than 1 gives us a smaller number; in other words, the gain A of the entire circuit is smaller than the gain G of the amplifier by itself.

Since negative feedback reduces the gain of an amplifier, you may be tempted to think that it is a bad thing. Actually, though, negative feedback is used a lot because, while it reduces the gain, it also reduces the distortion of the amplifier and improves other factors. Almost every hi-fi amplifier uses it to improve operation.

(B) Positive feedback, however, is what we need to make an oscillator. With positive feedback, the signal being fed back into the summer is *in* phase with the input signal ($V_{in}$), and so it adds to the input. This gives the amplifier more input than it would otherwise have, and so there is a larger output voltage ($V_{out}$) than before.

Returning to our equation, suppose that the product GH was a positive number such as +0.5 or +0.8; it would then subtract from the 1 in the denominator, making the denominator smaller than 1. From the equation, we see that dividing the amplifier gain G by a number smaller than 1 would make the quotient larger. This increases the gain, but it also reduces the amplifier quality. If the amplifier produces some distortion, then some of that distortion is sent back to the amplifier and amplified again; the output therefore has even more distortion than before. Positive feedback is therefore not generally used in plain amplifiers, unless you need more gain than the amplifier can produce by itself.

Now, suppose that the gain G of the feedback circuit were carefully adjusted so that the product (GH) were *exactly* equal to +1. Then the denominator of the equation would be 1 - 1, or exactly zero! Since dividing the amplifier gain G by zero gives infinity as the answer, the gain of this servo loop would be infinite. In other words, there could be an output from the circuit even though there is no input. As it happens, that is exactly what we want from an oscillator!

An oscillator is therefore an amplifier with a positive feedback loop around it. The feedback loop is adjusted so that its gain H is exactly equal to 1/G at whatever frequency we want it to oscillate at

(so that the product of G X H is exactly equal to +1).

END OF DETOUR

**Fig. 5** shows a Hartley oscillator circuit. The circuit is very simplified, and needs some more components to make it work. For example, there is no biasing for the transistor—but the important components are there. It works like this:

First, note the tuned circuit, consisting of inductor L1, and capacitor C3. This circuit sets the frequency of operation. At the same time, inductor L1 acts as an *autotransformer*. (An autotransformer acts very much like a normal transformer, but, to save money, it combines both the primary and the secondary windings into one. In this case, the entire inductor is the secondary, while the portion from the tap down to ground is the primary). Since the secondary has more windings than the primary, the output voltage from the autotransformer is larger than the input voltage and, therefore, the gain (which is actually the H in the above equations) is greater than 1.

The transistor is connected both as an emitter follower, and as a common-emitter amplifier. As usual, the emitter follower circuit has a gain slightly less than 1; this gain is the G in our previous equations. The output from the transistor goes into the tap of the inductor (the primary), while the output from the top of the inductor (the secondary) is the input into the transistor's base.

So the transistor provides the gain G (which is smaller than 1), while the tuned circuit provides the feedback H (which is larger than 1). Multiply the two out, and you get the product (G X H = 1) that is needed for oscillation. Once the transistor oscillates, the output is taken from its collector.

Now let's look at capacitor C2, and the components to its left. C2 is relatively large, so that at the frequency of oscillation it behaves almost like an AC short circuit. Hence, for AC purposes, the varicap diode

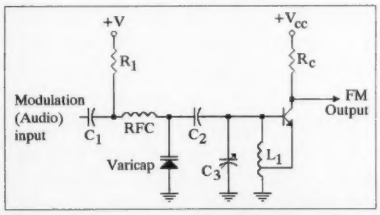


*Fig. 5. A frequency-modulated Hartley oscillator.*

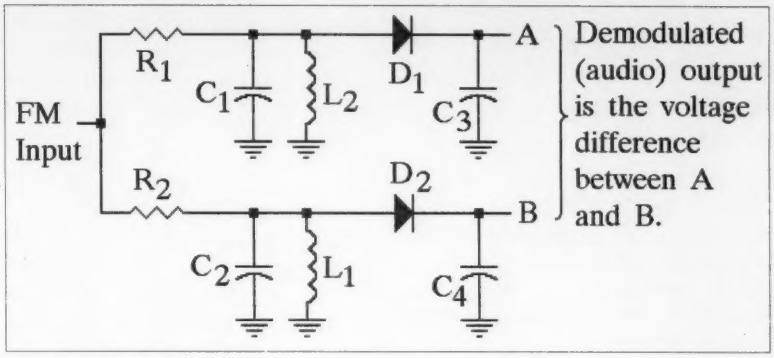


*Fig. 6. A simple FM demodulator.*

is connected directly across the tuned circuit. The exact oscillation frequency, therefore, depends not just on L1 and C3, but also on the capacitance of the varicap (notice the symbol for the varicap—a diode whose cathode side consists of two lines, like a capacitor).

In order to produce the depletion region in the varicap, the varicap is reverse-biased by connecting its cathode to +V through resistor R1, but note how the audio voltage comes in through capacitor C1 on the left. This audio voltage adds to, or subtracts from, the voltage +V, so the width of the depletion region varies with the audio. That changes the capacitance, which in turn changes the frequency of oscillation, giving us FM.

Finally, note the inductor labeled RFC. This is an RF Choke—a small inductor whose purpose is to keep radio-frequency signals from flowing through it. It keeps the high-frequency signal at the tuned circuit from getting back into the audio or +V bias circuit. Capacitor C2, on the other hand, does the opposite, keeping the audio and DC voltage across the varicap from getting to (and being short-circuited by) inductor L1. We can't connect the varicap diode directly across the tuned circuit since it has to be reverse biased, and the inductor would short the DC bias voltage.

There are other ways to generate FM, but the varicap circuit is the simplest and most obvious. Its disadvantage is that it produces some distortion; hence, it is most often used for voice or data communications, and seldom for high quality music.

## Detecting FM

Just as there are various ways of producing FM, so there are many ways of detecting (or demodulating) it. Let's begin with the very simple circuit of **Fig. 6**.

Let's assume that the FM carrier has a center frequency of 10.7 MHz, and that it varies above and below that value. Let us tune the two resonant circuits so the top one, consisting of L1 and C1, is resonant at 10.8 MHz, while the bottom one, consisting of L2 and C2, resonates at 10.6 MHz. Further, make R1 and R2 the same, R3 and R4 the same, and C3 and C4 the same.

Start with the FM input at 10.7 MHz. The input signal is split by resistors R1 and R2 into two paths: Part of it goes to the top tuned circuit, part to the bottom. The top resonant circuit is tuned 100 kHz too high, while the bottom one is tuned 100 kHz too low, so the input signal appears across both tuned circuits, slightly attenuated (since the signal is not at resonance), but almost exactly the same amplitude.

Like the diode and filter capacitor in a power supply, diode D1 and capacitor C3 rectify the AC signal from the top tuned circuit into a positive DC signal, and filter it. Likewise, diode D2 and capacitor C4 rectify the AC signal from the bottom tuned circuit.

Since the AC signals across the two tuned circuits are about the same amplitude, the DC voltages across C3 and C4 are also equal. Points A and B therefore have the same voltage. The voltage between A and B is the actual output, which is zero.

Now suppose the frequency increases above 10.7 MHz. Since the signal is now closer to the 10.8 MHz resonant frequency of the top tuned circuit, the AC signal across that circuit increases; likewise, the AC signal across the bottom tuned circuit decreases because the input frequency is now farther away from the 10.6 MHz

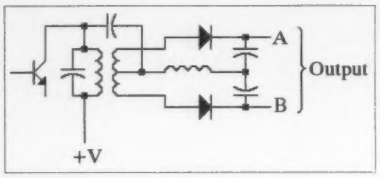


*Fig. 7. Foster-Seeley discriminator.*

resonant frequency of that circuit. Point A is now more positive than point B, and so the net output voltage is positive. In fact, the closer the input frequency gets to 10.8 MHz, the bigger the positive output.

In exactly the same way, if the input frequency drops toward 10.6 MHz, point B becomes more positive than A, and so the difference between A and B becomes negative. The more it drops, the more negative the output gets.

In other words, the output voltage is proportional to the frequency of the input signal—when the frequency goes up, the output voltage goes positive; when the frequency goes down, the output voltage becomes negative. This converts the frequency changes of the FM signal back into the original modulation.

While the circuit of **Fig. 6** would work, the fact that it has two tuned circuits makes it too difficult to adjust. It also has a bit too much distortion. Most receivers therefore use a slightly different circuit.

**Fig. 7** shows one common circuit, called the *Foster-Seeley Discriminator* (don't confuse this with two companies, one called "Stearns-Foster," and the other called "Sealy"—they make mattresses, which have nothing to do with FM). By relying on the phase differences between several signals, the circuit produces voltages at the two diodes which depend on the frequency. By the time the signals are rectified and filtered, we again have a demodulated output which depends on frequency.

The circuits of **Fig. 6** and **Fig. 7** both have one disadvantage; their output voltage also depends on amplitude—the stronger the FM input signal, the greater the output voltage. This means that noise (which changes the input voltage) would get through the detector circuit. As we pointed out earlier in this chapter, one way to avoid this problem is to put a limiter in front of the detector; the limiter keeps the input signal at a constant height, and so avoids the problem. This means we need to add one more circuit to the radio, so many designers try to cut costs by using a slightly different circuit, called a *ratio detector*. Instead of taking the difference between the two diode outputs in a pair of resistors, the ratio detector looks at the *ratio* of the two diode voltages. Regardless of how strong or weak the signal is, at any given frequency the ratio of the two signals should be the same, and so this circuit ignores any amplitude changes in the signal. In many cases (especially in commercial FM broadcast receivers) that eliminates the need for a limiter, and cuts cost.

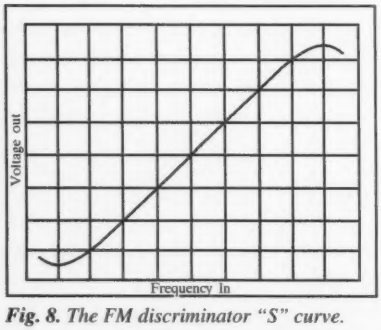


*Fig. 8. The FM discriminator "S" curve.*

**Fig. 8** shows the output-vs.-input curve of a typical discriminator or ratio detector; you can see why it is often called the "S" Curve. It shows how the output voltage (the vertical axis) depends on the input frequency (the horizontal axis). If the circuit is well designed, then the center of the curve should be as straight as possible, to make the output voltage exactly proportional to the frequency change, and produce the lowest distortion. The ends of the "S" curve are curved, but the FM signal usually doesn't change frequency that far up or down, so it doesn't matter.

### FM sidebands

Like AM, transmitting an FM signal results in sidebands, and those sidebands increase the bandwidth of the FM signal.

Let's start by looking at **Fig. 9**. At the top, we have 10 cycles of an unmodulated carrier with a constant frequency. Note the vertical lines, which cross the carrier signal exactly at the top of each cycle. If you carefully measure, you will see that the distances between all the lines are exactly the same, which proves that each cycle is exactly the same length.

Below the carrier we see two sidebands: the upper sideband, with a slightly higher frequency (it shows 11 cycles instead of 10); and the lower sideband, with a slightly lower frequency (it shows only 9 cycles.)

In the bottom waveform, we used a computer to sum the carrier and sidebands to produce a resulting waveform. Like the unmodulated carrier at the top, it shows 10 cycles, but these cycles are not all the same width—you can see that the vertical lines cross the bottom wave at different places in each cycle. From this, we conclude that the FM signal at the bottom is changing frequency (because some cycles are longer and some are shorter), but that the average frequency is the same as the unmodulated carrier. In other words, modulating the carrier to produce FM varies the frequency back and forth, above and below the "resting" or unmodulated value.

We therefore see that, like an AM signal, an FM signal consists of a carrier plus sidebands. But there is one catch—if you examine **Fig. 9** carefully, you can see that the cycles of the FM signal at the bottom are not all the same height. In other words, the frequency is varying, but so is the amplitude. This can't be! There is something wrong here! FM is supposed to stay the same amplitude all the time, not change! What's wrong?

The problem is that **Fig. 9** doesn't tell us the whole story. **Fig. 9** would be good enough to explain FM *if the two sidebands were much smaller*. When the amount of FM modulation is very small (for example, when the music on an FM station is very soft), one tiny set of sidebands, much smaller than those shown in **Fig. 9**, is enough to swing the resulting FM carrier back and forth in frequency a small amount without changing the amplitude.

On the other hand, when an FM station transmits loud music (which produces much more modulation), the simple picture in **Fig. 9** needs something else (let's call it a "finagle factor"), something which will keep the amplitude constant.

This "finagle factor" is another set of sidebands. A real FM signal usually contains more than one pair of sidebands; there could be dozens or even hundreds of sidebands on each side of the carrier when there is a *lot* of modulation.

**Fig. 10** shows how adding just one more set of sidebands can fix the problem of **Fig. 9**. Here we see the following: the original unmodulated carrier with 10

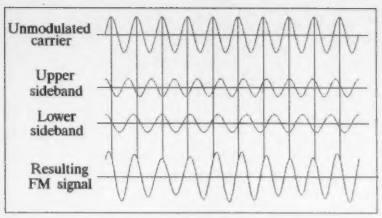


*Fig. 9. FM from one set of sidebands.*

cycles, one pair of 1st sidebands, an upper one with 11 cycles, and a lower one with 9 cycles, a pair of 2nd sidebands, an upper one with 12 cycles, and a lower one with 8 cycles, and the resulting FM signal with 10 cycles of varying frequency, but constant amplitude. So we see how adding just one additional set of sidebands (with frequencies different from the first set) can fix the amplitude variations.

As we mentioned earlier, with more modulation, even more sidebands might be required to keep the amplitude constant. So we need to learn how to measure the amount of modulation. This can be done in two ways—using the deviation, or using a modulation index. Two methods that will, unfortunately, have to wait until next time. 73

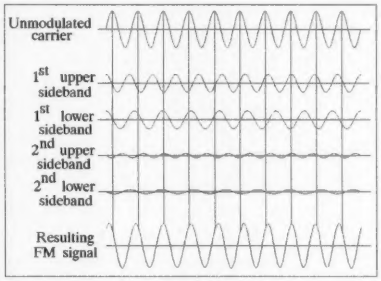


*Fig. 10. Multiple FM sidebands.*

## NEVER SAY DIE

*Continued from page 45*

else. We had a ball converting the Command Sets, SCR-522s, and other stuff. And we learned from doing it.

For my part, I got started building stuff in 1937. It started with a box of old radio parts someone brought to the church and gave to my pal Alfie. He had zero interest in that old junk, so he gave it to me and I used the parts to build a cigar box radio. Which worked! I was hooked. Friends of my family dumped dozens of old radios from their attics on me. I took 'em all apart, building up my junk box. I hate to think what those old radios would be worth today if I'd boxed 'em up and stored 'em. Lordy.

Like everyone else, I memorized the *ARRL Q&A Manual* and passed my ham ticket. Sure, I could build things from magazine articles, but I hadn't a clue as to how elctricity worked. In that way I was like almost every other ham I'd met. When WWII came along we all got thrown off the air in December 1941. In 1942 I joined the Navy and they put me through a three-month course in the fundamentals of electricity at Bliss Electrical School. It was a fabulous course.

After that I went on to the Navy Radio Materiel School on Treasure Island (San Francisco) for six more months. By the time I graduated I could repair anything electronic: test equipment, receivers, transmitters, antennas, sonar, radar, and so on. Bliss gave me my understanding of the fundamentals which has helped me cope with the development of solid state, computers, and digital electronics.

After I graduated from Treasure Island I volunteered for submarine duty and was sent to Pearl Harbor as an Electronic Technician 2/c on the submarine tender Sperry. In 1943 I was transferred to the *Drum*, where I was in charge of everything electronic. And had plenty of exciting adventures...which are described in my *WWII Submarine* book.

That's the kind of thing amateur radio got me into.

Maybe now you can understand why I've been pushing ham clubs to provide technical sessions before every club meeting. These will help newcomers and old timers (too) build an understanding of the fundamentals instead of just memorizing the *ARRL Q&A Manual*, like we all did 60 years ago and newcomers still are doing today.

Not only is learning new things fun, but it also helps your mind develop. Like the rest of your body, your mind is a use-it-or-lose-it module.

If the newcomers to our ham bands aren't operating the way we want them to, that's due to what they're learning from us old timers, not what they may have brought from CB. If there'd been a CB band in the 1930s I'd have been on it and had a ball. With few exceptions, the absolute worst operators I'm hearing on our bands these days are old timers, not the no-code newcomers. That mess on 14,313 was all made by old timers. And look what K1MAN, who at 54 should know better, has been doing to our bands!

In the past our worst ever operators were all old timers. W2OY and W2BIB were infamous. OY used to sit on the low end of 75m on AM and put down sideband, newcomers, youngsters, and so on. BIB made his mark by doing his best to jam emergency medical traffic with Africa. Have any of you old timers any other nominations for the Ham Hall of Shame? Hmm, I almost forgot W2HH, who spent much of his later years jamming 75m DX contacts with CW. Say, wasn't he a former ARRL director, and the father of some forgotten ARRL president?

But for every Hall of Shamer we have ten hams who deserve medals for their contributions.

Getting back to the stuff in Florida Skip, there's a really stupid comment about the ham manufacturing and distributing lobbies influencing legislation. In some other field, maybe. But this guy, being relatively new, maybe hasn't noticed that the Japanese almost completely dominate the ham market here. Yes, they should fund a lobby, but unless it's been kept a secret (which is unlikely), they haven't. The American ham industry hasn't been able to get together to do anything. Most of 'em don't even bother to come to ham the industry meetings at Dayton. And when I offered to try and organize a manufacturer's group to work with the FCC as advisors, I got almost no response.

Twenty years ago we had an active FCC National Industry Advisory Committee (NIAC) which met in Washington with the FCC staffers to discuss ham regulatory matters. The Committee had originally been formed as a prestige deal which was completely controlled by the ARRL. Some ham FCC staffers got really fed up with NIAC doing nothing and organized a revolt which got rid of the pompous do-nothings and brought in some movers and shakers (including me). For several years all of us flew to Washington at our own expense to provide the guidance the FCC wanted and needed. I'll tell you more about that era some time.

It's a pity when ham publications help spread misinformation like that. Yes, it's a lot more trouble for writers to do their homework before writing, but then they'll be able to share their knowledge with us instead of displaying their ignorance and prejudices.

### The New York World's Fair Fiasco

The Silent Key announcements for Bill Leonard W2SKE and Stu Meyer W2GHK, both around my age, got me to remembering some ham history that few hams today probably know about and most old-timers have forgotten. Bill used to be the president of CBS News and Stu was the president of Hammarlund. Both were good friends.

Bill and I spent a couple of months flying around the world together in 1959 on an Air Force C-54. We had a sideband ham station with us on the plane with which we made thousands of contacts as we flew from New Jersey to Newfoundland—Bermuda—The Azores—Scotland—Paris—Haderslev, Denmark—Berlin—Rome—Athens—Alexandria, Egypt—Aden—Karachi—Colombo—Bangkok—Saigon—Philippines—Naha, Okinawa—Taipei—Seoul—Tokyo—Guam—Wake Island—Honolulu—Travis AFB—Omaha—Dayton—Washington DC—and back to New Jersey. We got to know each other pretty well.

My story has to do with the New York World's Fair of 1964-65 and the ham radio exhibits therein. I'll tell the story as I recall it rather than digging out my old issues to get the details exact.

It all started when Bill, who was quite a celebrity as the head of CBS News, found out that Coca Cola was looking for a theme for their World's Fair pavilion. Bill called the president of Coca Cola and suggested that the exhibit be built around amateur

*Continued on page 81*

# RTTY LOOP

## Amateur Radio Teletype

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From the spread of questions received from readers of this column, it would appear that you all divide into two basic groups. There is, of course, the experienced RTTY-phile contingent, and there is a group to whom much of this is a mystery. That latter group is the target of this and the next few months' columns.

The question to be addressed this month is, "Just how do you get digital information, letters, and numbers on a radio signal?" Remember that the technology we have today, computers and the like, did not exist when radioteletype started, so our system will have to allow for techniques of 50 or more years ago.

To begin with, understand that a "digital" signal is just one which is being turned on and off, which we can view as being alternated between a mark and a space state. So, let's begin without radio, by stringing a wire from here to there, and putting a light at one end and a switch at the other. **Fig. 1** will help with an understanding of this complex concept. If I want your attention, and I am here and you are there, I can just light the light. At the simplest level, we could even agree that one blink of the light means one thing, and two or three blinks means something else. The trouble with this scheme is that the number of blinks gets cumbersome fast.

So, along comes someone (I will leave alone the argument of whether or not it was Samuel F. B. Morse for now) who devises a code scheme that encodes all letters as groups of short or long pulses. Now we can use the wire and light to spell out words, numbers, and whole thoughts. Unfortunately, the code groups used for the letters and numbers are of varying lengths, making any attempt at automatically decoding them with some kind of mechanical device fraught with difficulty.

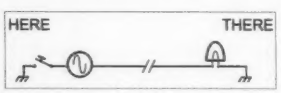


*Fig. 1. A switch at one end of a wire that turns a light bulb at the other end on and off illustrates a crude form of code communication.*

OK, so if we confine ourselves to just the 26 letters of the alphabet, and want to come up with a scheme that could automate transmission, we might brainstorm the scheme shown in **Fig. 2**. Here, 26 wires, one for each letter of the alphabet, are strung between two points. Extra wires could be used for numbers and punctuation, and one could even postulate stringing another wire for a SHIFT key, such as on a typewriter, to produce capital letters. Using modified electric typewriters at either end, we could have a workable scheme here. Of course, the expense of stringing who knows how many wires from here to there will be somewhat prohibitive, and looking into the mode's future, are we talking about 26 radio frequencies? The mere thought makes me shudder.

So, we have to get clever. First of all, let's look at just how you can encode information. One pulse, such as we have been using, can encode two states, ON and OFF. What if we used two pulses in sequences, each one of which can be on or off? With ON represented by "1" and OFF by "0," possible combinations would be 00, 01, 10, and 11—four distinct codes. In fact, the number of codes is two raised to the number of pulses used. So, using five pulses, 32 code groups are possible, enough to encode all 26 letters, as well as some punctuation and machine functions. A SHIFT function will give another set, for numbers and even more punctuation. **Fig. 3** shows, in chart form, the whole scheme, commonly called the Baudot or, more properly, the Murray code.

Well, we have a way of encoding the information, but how can we send it over a single wire or frequency? Well, we could back down to the multiple wire scheme, using only five wires—one for each bit of the Murray code. In fact, these days, we would call that "parallel" communication, and that really is how most computers talk to their printers. But that is not the topic of this column, and not the way radioteletype is transmitted. No, we are going to have to confine ourselves to one wire, or one frequency.

Although I will leave out some of the specifics, as they vary with machines, imagine a rotating wheel that encodes the five bits to be sent in sequence, producing a sequence of on and off pulses to describe each group. At the receiving end, we will place an identical rotating wheel, rotating at the same speed, which directs each incoming pulse to a magnet, which holds down a selector, which decodes the letter. Neat, huh? Of course, the two wheels need to be turning at precisely the same rate, and remain in perfect sync. Not an easy task, folks! Actually, this scheme is in use, and called "synchronous" transmission; it's just not the way we are used to doing it.

No, we took a simpler approach. Still two wheels, still rotating at the same speed, although speed is a tad less critical, but now add two pulses. A START pulse, always SPACE, is sent from the sending machine, and tells the receiving wheel to start rotating. Then come the five data pulses, with the receiver sampling only the middle of the pulse. By sampling the middle of the pulse, a speed drift of a few percent will not affect transmission. Finally, a STOP pulse, always MARK, concludes each character, and sets the system up for the next character. This "asynchronous" transmission, although it looks continuous, is, therefore, really a series of individual character bursts. **Fig. 4** is an attempt to diagram such a setup.

Now all you have to do is connect the two machines by wire or radio, and you have a workable

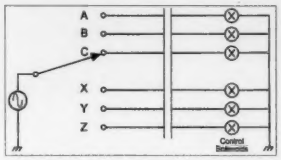


*Fig. 2. A way for two machines to exchange information is to string 26 wires between them, one wire for each letter of the alphabet.*

scheme. As to the specifics of that radio connection, that is a topic for another column. Hopefully, this explanation helps demystify what some of you consider an enigma: Just how do letters and numbers get encoded onto one signal?

By the way, lest you think this scheme ends with radioteletype, if you expand the number of pulses to seven, you will have two to the seventh power, or 128 possible characters. Filling in all the upper and lowercase letters, numbers, punctuation, and some odd characters yields the American Standard Characters for Information Interchange, ASCII, the character set behind most computer communications. This asynchronous data transmission mode all started with a teleprinter. Imagine that!

Fast-forwarding to the present, but staying with the question of interfacing, I have a letter here from Elmer Sterkel KØUYE, of Loveland, CO, who is interested in the Snappy Video Capture mentioned a few months back. He has HP Deskjet 660C, and wonders how you hook the whole thing up.

Well, Elmer, if you only have one parallel port (see, I told you this would come in handy), you have to use a switch to select which device the port sees, the Snappy or the printer. The Snappy does not feed the printer port through, making such a switch mandatory. The alternative would be to use a second printer port, if one is available, or to install a card to create one. I purchased a switch from a local computer superstore for under $30. **Fig. 5** shows how to hook the whole thing up; it's really not very complicated. If you have a second printer port, just put the Snappy on LPT2, it will configure for that port and

| Code Bits | | | | | | | Code Bits | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 4 | 3 | 2 | 1 | LTRS | FIGS | 5 | 4 | 3 | 2 | 1 | LTRS | FIGS |
| 0 | 0 | 0 | 0 | 0 | Blnk | Blnk | 1 | 0 | 0 | 0 | 0 | T | 5 |
| 0 | 0 | 0 | 0 | 1 | E | 3 | 1 | 0 | 0 | 0 | 1 | Z | " |
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*Fig. 3. The Baudot, or Murray, code.*

function just fine. The Snappy itself is widely available, and the price seems about the same at every source I have looked at.

Good luck, enjoy, and be sure to send me a sample of your efforts for inclusion in this column and on the web site.

The RTTY Loop Home Page, by the way, is continuing to attract a good deal of interest. Check it out at http://www2.ari.net/ajr/rtty for columns, downloads, links, and information on the growing RTTY Loop Software collection. I look forward to your questions and comments, by E-mail at ajr@ari.net, on America Online at MarcWA3AJR, or CompuServe at 75036,2501; or via snailmail to the address above. Be sure to include an SASE if you desire a response to snailmail correspondence. Next month, more on the series of basic radioteletype principles. 73

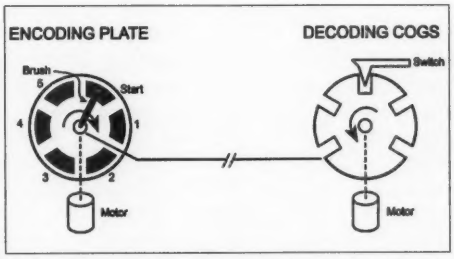


*Fig. 4. The rotating wheels in each machine that spin at exactly the same speed are the backbone of "synchronous" transmission.*

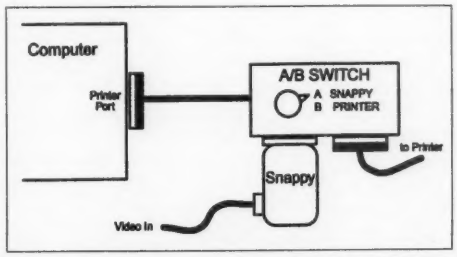


*Fig. 5. How to hook up Elmer Sterkel KØUYE's Snappy Video Capture system when a second printer port is unavailable.*


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# QRP

*Number 72 on your Feedback card*

## *Low Power Operation*

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

Summer will be quickly coming to a close, so let's preview a simple project to start off the winter building season. But first off, a condensed look at the QRP activity at the Dayton Hamvention 96.

### QRP at Dayton Hamvention 96

The Four Days In May, for a first-time event, was a great success! All those who attended found the activity well worth the time and money. Without question, there will be another Four Days in May for 1997, but right now, I don't have the names or numbers to give you. When I know the people to contact, you'll be sure to find the information here.

The Friday night dinner was also a success! With over 100 people in attendance, it was the largest group we have had so far at the Hamvention. At the dinner, my two paid hecklers, Randy KD8JN and Scott N8JSK, conspired against me with bogus badges made up for the entire group. Somehow I became a spokesperson for a well known high power RF amplifier company. Not only did most of the QRPers at the dinner wear badges, the hotel staff did as well! Wait until next year!

Thursday and Friday nights were show and tell. Many of the vendors had equipment set up and running. S&S Engineering were showing off their new DDS VFO. Index Labs had the new QRP Plus on hand. Also on hand were the Atomic keyer, the Small Wonder Labs 20 meter SSB rig, the Wilderness Radio version of the Norcal 40, and the Sierra. I introduced my Micro "M" solar controller on Thursday evening. I know I missed some of the vendors; I always tell myself to make a list, but like the previous years, I forgot.

### Clubs

We had, on Saturday night, just about every QRP club alive. The QRP ARCI, The M-QRP club, Norcal, New England, St. Louis QRP club, G-QRP, Colorado QRP Club, Northwest QRP club, and a few from out of the country. Making its debut was the QRP-L group, found on the Internet.

### New stuff

I was surprised by the number of hams who were buying old QRP rigs and accessories. Heath HW-7s were going for $150. HW-8s were on the tables for over $200. Century 21s were $300, for the analog versions. In fact, someone (was that you, Doug?) purchased a used Ten-Tec microphone for the Argonaut 509 for $75! It's no wonder that the three I had on my table in the flea market went so fast. Had I known, I could have made a bundle. I had two Electro-Voice microphones, made for Ten-Tec, in the original boxes, and sold them Friday morning, as soon as the flea market opened. I wondered why the guy who purchased them didn't dicker. Oh yes, I sold the two for $20 each. The third one had no end plug—it went for $15. Oh well, live and learn!

### QRP ARCI

Several items were taken up at the annual board of directors meeting. First, there will be a dues increase. The exact dollar amount has not been set at the time this is being typed. It's been a very long time since the QRP ARCI has had to increase dues, but it's become necessary because of the increases in postage and printing costs of *The QRP Quarterly*. Also, for DX members, the price of first class air mail is slowly bankrupting the club. Right now, a DX membership is $12. It costs anywhere from $3.70 to $6 for air mail, depending on the destination. It doesn't take a college education to tell you it costs more to mail out *The Quarterly* than we collect in dues. As a temporary fix, all DX members will have their copies mailed by surface mail instead of by air. This will be *only* for the short term. Look for QRP only ads to appear in *The Quarterly* as a means to offset the constantly rising postage costs.

### Membership and subscription problems

If you have a problem with your membership in the QRP ARCI, contact me, not the prez, the vice prez, or the QRP-L group on the Internet. I'm the only person who can fix the problem. I, and I alone, have the database files. Write to me at the address at the top of the column. You can send E-mail at one of two addresses; 73357.222@compuserve.com or prosolar@imperium.net. I prefer that you use the E-mail going to the CompuServe address. Imperium net has been less than 50% available to me most of the summer.

### Solar power revisited

Seeing three flea market spaces filled with solar modules and controllers, I noted a great interest in large high-power modules this year. In the years past, most of the QRP operators went for the 5 and 10 watt Solarex Lites. These make taking solar power and your favorite QRP rig into the field lots of fun. This year, most of the guys wanted larger, more powerful modules for use at home.

I also wanted a higher power module to increase my energy production, so I have installed two Astro power 120 watt modules on a pole mount. These modules will be used to test new control circuits. When not used for testing, their output will be redirected to the main storage battery. I plan on adding four more 120 watt Astro modules during the summer of 97. Also, two more 64 watt Solarex MSX-64 modules will be added to the main array before you read this. This will boost the peak current going into the storage batteries to over 73 amps at 17 volts. Although it isn't yet carved in stone, by the time you read this, my entire solar energy control system will be scrapped and a newer version in place. This time around we will go to a 24 volt system and use a single 3.5 kW modified sine wave inverter to supply power to the shack and the rest of the home. I will keep some of the low voltage lighting, now running on 12 volts, by using a DC to DC switching converter.

Low voltage fluorescent lighting can cause all kinds of RFI. The switching ballast used in the low voltage fluorescent lights generates a signal from DC to light! By using a separate inverter, I should be able to eliminate most of the RFI now caused by my lighting system.

### A portable solar panel tester

This project came about out of a need to test surplus solar panels, without dragging along an expensive digital voltmeter. The tester will check for open circuit voltage and short circuit current of any solar module up to 180 watts. The maximum current the meter can handle is 10 amps.

The meter is very, very simple. In fact, instead of using a PC board, all components mount on a piece of perfboard. In fact, there are only a handful of parts needed.

The solar tester is built around a Jewel LCD meter display. The basic movement has a range of 0 to 200 mV. You can use just about any digital panel meter with an input of 200 mV. I've seen some really good prices for DPMs at hamfests. Some can be had for under $10.

To measure voltage, we need to scale the incoming voltage down to the level required by the meter.

Since the open circuit voltage of a nominal 12 volt solar panel is around 21 volts, I scaled the meter to display a 200 volt range. So, when connected to an open circuit solar panel, you'll see 21.0 volts displayed. The 200 volt scale was needed because the meter would display an over range error if scaled to a 20 volt range.

To set the meter's scale, two .1%-tolerance resistors were used. These guys are available from Mouser Electronics™ for about two bucks each.

This gives us the voltage measurement. To measure current, I used 10 .1 Ω 5 watt power resistors in parallel. The total resistance for the 10 resistors is .01 Ω. With the meter's nominal 200 mV input across the shunt resistors, 10 amps of current will drop 100 mV, so the meter will display 10.0 amps. The combined wattage of the shunt resistors is 50 watts—the shunt should be able to take a 10 amp reading for 15 seconds or so before heating up.

The hardest part of the project is coming up with a simple

*Continued on page 83*

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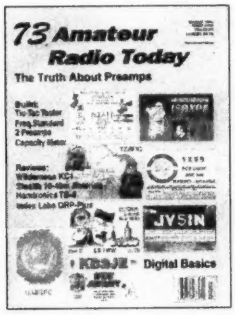


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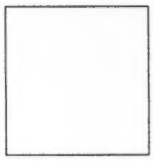

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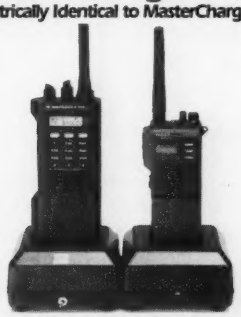

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Pete Kemp KZ1Z
Bethel Educational ARS
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600 Whittlesey Dr.
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Students love to communicate. They don't want to feel left out of anything! Many female middle school students are even known to write lengthy messages to fellow students, chock-full of all the latest information, when the slightest need is perceived. To harness this energy, and to take advantage of middle-schoolers' innate desire to know what other students are doing everywhere, radio E-mail fills the bill. While landline Bulletin Board Systems (BBSs) can pass E-mail, you need a modem and a computer to receive the mail. Using packet, you have the option of utilizing the ARRL's National System (NTS) for delivery via a friendly telephone call or communicating directly with other schools who use packet radio.

To use packet radio in the classroom, proper preparation must be made for a successful experience. A number of issues must be addressed:

**What equipment is needed?**

A basic packet radio system consists of a VHF transceiver, antenna, Terminal Node Controller (TNC), and computer/software or data terminal. You don't need to have a big full-blown VHF monster station to participate actively. A successful project may be accomplished from a permanent station, or a portable one, using a laptop computer, TNC, and an HT with a rubber duck antenna.

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    All the Best of the Holiday Season!
                  from
              KZ1Z and the BEARS
The Bethel Educational Amateur Radio Society
```

*Fig. 1. Sample message.*

**What is the purpose of your communication?**

Before sending out any message you must have a purpose. No one appreciates radio junk mail; it ties up nets and clogs up busy packet frequencies and computer space on packet bulletin boards. Some message subjects to consider when starting out include interdisciplinary work combining technology and language arts, computer science, art, science, math or other academic disciplines of the curriculum. The beauty of this medium is that you are limited only by your own imagination and common sense.

Surveys requesting information on a variety of subjects, such as political straw polls, musical groups, or other student-oriented issues, will usually strike a responsive chord among fellow students. Data retrieval for scientific interpretation or mathematical statistical work is an excellent first project for packet E-mail. For example, you may ask participants to send in the high and low temperatures for their area on a specific day or week, identifying their geographic location by using longitude and latitude. The data may be used for lessons in social studies classes, for meteorology lessons in science class, or in mathematics for drawing charts and graphs. You could even share the data for input in computer science classes for spreadsheet work, transforming the data into a variety of graphic representations.

```
                    ////
                   (o o)
*-----------------oOO-(_)-OOo-----------------*
| |
| We hope that you had a great summer. The school year |
| ahead is ripe with opportunities for personal and |
| academic growth. The BEARS wish you a fantastic |
| school year filled with ham radio fun. |
| |
| 73 Pete, KZ1Z and The BEARS |
| Bethel Educational Amateur Radio Society |
| Bethel Middle School |
| Bethel, Connecticut |
| *-------------------------------------------*
```

*Fig. 2. Sample message.*

Celebration messages are a lot of fun. Students can send messages to other students and schools wishing them all the best during a holiday season, congratulating them after the school has received an honor or award, or praising a successful sports endeavor.

ASCII graphics can be especially effective for spicing up messages via non-NTS (the ARRL National Traffic System) circuits. Keyboard art has been a part of amateur radio for years on RTTY and it has a place on packet, too (be careful not to send long pictures, as they won't make you many friends in the packet world). Recent software and TNC developments also allow for ANSI picture transfers, but special care must be taken to be sure that the format is appropriate, as you would not want to send control characters, which may be misinterpreted by non-compliant systems. ANSI graphics are not compatible with DX packet clusters.

Just being a nice person has its own rewards and is an ideal way of facilitating personal communications. Consider contacting former students who have moved away from the community, just to ask how they are doing. A friendly message from back home is always appreciated. Packet may also be used to

```
        o  School will be starting soon. The BEARS wish you
    _ /-_     all a GREAT school year, full of high
....(_)>(_)   academic achievement and ham radio fun.
_____

          73...Pete KZ1Z & the BEARS
      The Bethel Educational Amateur Radio Society
                Bethel Middle School
                 Bethel, Connecticut
```

*Fig. 3. Sample message.*

keep alumni students informed of local events and reunions. "Happy Birthday!" messages are always fun. You may wish to seek out new students at your school and ask them if they would like to send a message to a friends back at their old schools or communities. This is an excellent way to bridge that awkward gap that exists whenever a student moves to a new town. It also gives students an opportunity to learn more about their peers and about other areas of the country. Military personnel also appreciate being remembered. Radio links in conjunction with MARS should also be explored.

### What system would be best for getting the message out?

NTS, the ARRL-sponsored National Traffic System, is an excellent way to get the messages out. Disseminating messages through NTS keeps the system alive and builds strong ties in the local and section levels.

While we often think of packet as the primary method of getting the messages out digitally today, you should not overlook the potential use of other modes, such as APLINK, AMTOR, PACTOR, HF packet, and RTTY. Many areas of the country also have long-established VHF packet to HF digital links.

### Message preparation

Messages should always be prepared in accordance with proper NTS format (see Appendix A) if you are not sending a message to a specific amateur radio station's home BBS. It is recommended that you also have a copy of the ARRL numbered radiograms.

The effective use of a text editor to prepare your messages off-line is strongly advised. This will allow you to verify content information, to check spelling, and to generate a bulk loading text file to upload messages efficiently. See Appendix B for details. Remember to always save your messages in a pure ASCII format. Imbedded control characters associated with specific word processing programs will cause problems during transmission and later printing.

If you will be uploading messages to a local BBS on a steady basis, it is a good idea to contact your local sysop ahead of time to set up forwarding paths and to see what other suggestions he or she can offer.

### Have fun!

Infusing radio E-mail into the classroom offers many opportunities and readily yields positive results. The educational process is enhanced by such hands-on practical activities. Many pen pals and long-lasting friendships (and funny stories, too) have been garnered through this medium. One divorced mother, living in another state, received a message from her son, delivered by a friendly radio amateur operator. The son reported to the class that his mom called him on the telephone late that night all excited to say that she had received his note. She then asked him to send another message, so she could chat again with the gentleman who delivered that previous message! One never knows where the power of E-mail will take you.

Working with digital communications over radio is like second nature for today's students who have grown up with computers, as they begin to understand that the Super Highway of tomorrow will extend to the sky, and will not be limited to traditional landlines.

*"Appendix A" continued on page 76*

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  Remember our Veterans, for without their contributions,
       Old Glory would not be flying and the greatest
    democracy in the world would be just a history lesson.

                Pete KZ1Z and the BEARS
          The Bethel Educational Amateur Radio Society
                    Bethel Middle School
                     Bethel, Connecticut
```

*Fig. 4. Sample message.*

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MENTION AD AND TAKE 5% OFF FIRST ORDER!
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HOT TIN-PLATED STEEL BOXES WITH DIVIDERS, ELIMINATE SPILLOVER OF UNWANTED SIGNALS!
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MODEL WxDxHin. A* B**
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SB-2 3.3x1.9x1.0 6.25 7.50
SB-3 4.2x1.9x1.0 9.50 11.25
SB-4 6.3x1.9x1.0 11.00 12.50
SB-5 3.3x2.7x1.1 9.75 11.50
SB-6 4.8x2.7x1.1 12.00 14.25
SB-7 6.4x2.7x1.1 13.75 16.25
SB-8 2.6x2.7x.63 7.25 8.75
SB-9 3.2x2.7x.63 8.50 10.00
SB-10 4.8x2.7x.63 9.25 11.00
SB-11 6.3x2.7x.63 11.25 13.25
FEED-THRU CAPACITORS
FTS-1 1000pF/500VDC SOLDER .88 .95
FTS-1 1000pF/600VDC SCREW-IN 3.60 3.75
ORDER TODAY! ($30.00 MINIMUM ORDER)
PRICES INCLUDE WORLDWIDE SHIPPING!
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Add $4.00 For Handling VISA M/C CHECK

ONV Belt W/O Seat Harness
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## Appendix A: ARRL Radiograms

The handling of radiogram traffic was the basis for the formation of ARRL, and a sizable segment of amateurs still makes this its principal amateur radio operating activity. Amateur radiogram service does not compete with other services, since there are no charges and there can be no guarantee. Provided FCC and international regulations are complied with, messages may be accepted from anyone for sending by amateur radio.

What constitutes "legal" messages, or any other kind of third-party communication, has been a matter of considerable discussion and various interpretations throughout the years. The pertinent regulations sections are: 97.3b, which defines an amateur operator as being a person "without pecuniary interest;" 97.112, which forbids any remuneration or other kind of compensation for use of an amateur station; and 97.114, which details certain prohibitions on third-party traffic.

Generally speaking, personal, non-business messages may be exchanged between different countries only after a special agreement has been reached between the countries. A list of countries which have signed such agreements with Canada and with the U.S. appears frequently in *QST*. In addition, most countries do not object to actual emergency radiograms being handled in the amateur bands if government or commercial facilities are not available at the time. Individual amateurs handle radiograms in a number of different ways. Some are "free-lancers" who handle their traffic on individual schedules without recourse to regular nets. Most traffic operators, however, participate in nets of various kinds. The largest organized system of nets is the ARRL National Traffic System. Others include networks organized by individuals for traffic-handling purposes in which individual amateurs participate out of preference.

### Originating radiograms

Any amateur can originate a radiogram on behalf of another individual, whether or not this individual is a licensed amateur. It is the responsibility of the originating amateur, however, to see that the message is in proper form before its first transmission because under most circumstances it is improper for a relaying or delivering station to make changes.

Each radiogram originated and handled should contain the following component parts in the order given:

(a) Number
(b) Precedence
(c) Handling instructions
(d) Station of origin
(e) Check
(f) Place of origin
(g) Time filed*
(h) Date
(i) Address
(j) Text
(k) Signature

*Optional with originator.

a) Every radiogram transmitted should bear a number. Keep a sheet with a consecutive list of numbers (beginning with "1") at your operating position. When a radiogram is filed at your station for transmission, complete all parts of the preamble except the number, leaving this blank. When you send the radiogram, assign a number to it from the number sheet, crossing out numbers on the sheet as they are used and making a notation, after the number, of the station to whom the radiogram was sent and the date. Such a system is convenient for quick reference purposes. Most traffic handlers start with number 1 at the beginning of each year.

(b) Every radiogram has a precedence in amateur procedure. This will normally be "Routine" (R). It is a separate part of the preamble and is transmitted as such, not as part of the number. Other precedences are "Emergency" (never abbreviated), "Priority" (P), and "Welfare" (W).

(c) Handling instructions (HX) are available prosigns for use when or if desired by the originator or the originating station, whenever special instructions are required in the handling of the radiogram.

(d) The "station of origin" is the call of the station from which the radiogram was first sent by amateur radio and is included so that handling stations will be able to communicate with the originator if something interferes with the prompt handling or delivery of the message.

(e) The "check" is the number of words and numerals in the text of the radiogram. Handling stations should agree on the check before the message is considered handled. (Full information on checking radiograms will be given later.)

(f) The "place of origin" is the name of the place (city or town) from which the radiogram was started, not necessarily the location of the station of origin. The preamble of a radiogram filed at League headquarters in Newington, Connecticut, might read as follows: NR 457 R W1INF 21 NEWINGTON CT 2057Z JUNE 11.

If a message is sent to your station by mail or otherwise not filed in person, the preamble should show the place the radiogram originally came from. If the radiogram came to League Headquarters by mail from Wiscasset, Maine, the preamble would read: NR 457 R W1INF 21 WISCASSET MAINE 2057Z JUNE 11. Any radiogram received at an amateur station by any means other than amateur radio is an origination when put on an amateur circuit by that station.

(g) The time filed is the time at which the radiogram is received at the station from which it is to be sent. Standard practice is to use UTC. This part of the preamble is optional with the originating station.

(h) The month and the day of the month that the radiogram was filed at the originating station. The year is not included. If the filing time is UTC, be sure that the date agrees.

(i) The address is the name, street and number, city and state of the party to whom the radiogram is being sent. The telephone number should be part of the address. A complete address should always be given to ensure delivery. When accepting a radiogram for origination, this point should be stressed. In transmitting the message by CW, the signal "AA" is used to separate parts of the address, and the address is followed by "BT," or "break," before the text is started.

In street addresses where the words "east," "west," "north, or "south" are part of the address, spell out "the words in full. Suffixes like "th," "nd," "st," etc., are not recommended. Example: "19 W 19th St" should be "19 West 19 St." It is not good practice for the relaying station to change address format, but the originating station should observe the above practices to ensure clarity in retransmission.

(j) The text consists of words in the body of the radiogram. No abbreviations

should be substituted for the words in the text of the radiogram. The text follows the address and is set off from the signature by another "BT".

(k) The signature is usually the name of the person originating the message. The signature follows the "BT" or "break" at the end of the text. The abbreviation "sig" is not transmitted.

After the signature, say "end" or transmit "AR." If there is more to follow, say, "more." On CW, use the prosign "B." If there isn't any more to come, say, "no more." On CW use the prosign "N."

**Counting words in radiograms**

The amateur radiogram "check" is the count of the number of words in the text only. It is essentially an "as sent" count. While it is assumed that the rules of grammar and spelling will be followed, the check count is determined principally by the spacing used by the transmitting operator in sending the text. Since the first operator to transmit the radiogram is the operator of the originating station who enters the check in the preamble, this check should carry through to the destination. The relaying operator has no authority to change the check unless it is definitely determined that the check as he received it is incorrect, then he should confirm with the transmitting operator before making the change. When such a change is made, the original check should remain in the preamble. Example: An original check of 10 corrected to 9 would be sent "10/9" on CW.

The check is a means of ensuring the accuracy and completeness of your copy. It also indicates to the receiving operator how many words the radiogram he is about to copy will contain. Inclusion of "check" in a message preamble is not optional.

Numbers, ciphers, mixed groups and punctuation each count as one in the check, regardless of length. It is recommended amateur practice not to use punctuation, fractions or other unorthodox or seldom used code symbols in messages as such, but rather to spell these out when used in the text of a message to avoid complications in checking. The letter "X" or "X-ray" is used in place of a period or semicolon and is counted in the check.

Special note: The ARRL-recommended procedure for counting the telephone number in the text of a radiogram is to separate the telephone number into groups, with the area code (if any) counting as one word, the three-digit exchange as one word, and the last four digits as one word. For example, 203 666 1541 counts as three words in the text of a message; 666 1541 counts as two words. Separating the phone number into separate groups also minimizes garbling.

The principle of counting words as sent can be illustrated by a few examples, as follows:

New York City....3 words
NYC.....1 word
Fifty six.....2 words
527B.....1 word
H O Townsend....3 words
W1YL/4..... 1 word

A few rules must be observed in sending words so that this principle of "counting as sent" will not be abused:

1) Make your spacing methodical and accurate on both phone and CW.

2) Follow the dictionary wherever possible.

3) Do not waste time in traffic nets arguing about "how to count." The purpose of the "check" in amateur work is to confirm the number of words or groups in the text. "QTB" is a useful signal in confirming check. Once you are sure that you have copied it correctly, "QSL" (on CW) or "roger" (on phone) the radiogram and get on with the next one, correcting the check when you relay the radiogram.

In copying traffic, whether by pencil or typewriter, it is quite easy, with a little practice, to count the words in the text as you copy. When using a pencil, copy five words to a line. At the end of the radiogram, you can readily figure the number of words by the number of lines (plus how many words over) you copied. By typewriter, it is more convenient to copy 10 words to a line, and this can easily be done by copying five words, hitting the space bar twice (instead of once), copying five more words, then line spacing to begin a new 10-word line. At the end of the radiogram, a glance at the number of lines will show you how many words you copied. You can then query the sending operator if your figure does not agree with his.

When traffic is heavy and time is precious, it is not considered advisable practice to query a check unless you have reason to believe that a mistake was made in either sending or copying.

**ARL check**

Messages containing ARRL numbered radiogram texts (see form FSD - 3) have the same form as any other radiogram, except that the symbol ARL (*not* ARRL) is used before the check. This symbol indicates that a spelled-out number in the text of the radiogram refers to a complete text bearing that number on the ARL list.

In delivering a message with an ARL text, you (of course) deliver the complete text. It is therefore very necessary that the symbol ARL be included with the check to avoid the possibility of delivery of a meaningless number to the addressee.

Use of ARL text is a special tool for special occasions. When used, it should be used properly to avoid delays and confusion.

**Appendix B:**
**Sample Bulk Text Format**

```
S WA3TQJ @ WA3TSW.PA.USA.NA
QTC

/EX
S KA4FZI @ KE2IX.#MYFL.FL.USA.NA
QTC

/EX
S KD8YY @ WB8CQV.WV.USA.NA
QTC

/EX
S WB1GXM @ WA1DSW.NH.USA.NA
QTC

/EX
S KBØCUS @ WBØAEX.KS.USA.NA
QTC

/EX
==========
```

Note: By using your text editor, you may use a Find and Replace routine to substitute "QTC" in the file with another "Topic" line.

Insert the required text in the space between the "QTC" and "/EX." "/EX" must be used to terminate the message as Control-Z will not work during bulk uploading.

When using NTS protocol, the "S" command should be substituted with an "ST" command. The receiving station becomes a ZIP code and the home BBS transitions to the proper NTS route, e.g. @ NTSCT.

*Number 78 on your Feedback card*

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The *73* Flea Market, Barter 'n' Buy, costs you peanuts (almost)–comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad. This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old-timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

**Send your ads and payment to: *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls. The deadline for the September 1996 classified ad section is July 12, 1996.**

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**WANTED: HAM EQUIPMENT AND RELATED ITEMS.** Donate your excess gear, new/old/in-any-condition to the Radio Club of Junior High School 22, the nation's only full-time nonprofit organization working to get Ham Radio into schools around the country as a teaching tool using our EDUCOM—Education Thru Communication—program. Send your radio to school. Your donated material will be picked up ANYWHERE or shipping arranged, and this means a tax deduction to the full extent of the law for you as we are an IRS 501(c)(3) charity in our 16th year of service. It is always easier to donate and usually more financially rewarding, BUT MOST IMPORTANT your gift will mean a whole new world of educational opportunity for children nationwide. Radios you can write off; kids you can't. Make 1996 the year to help a child and yourself. Write, phone or Fax the WB2JKJ "22 Crew" today: **The RC of JHS 22,** POB 1052, New York, NY 10002.*24 hours* call 516-674-4072 or Fax 516-674-9600. Join us on the WB2JKJ CLASSROOM NET, 7.238 MHz 1100-1230 UTC daily and 21.395 MHz from 1300 to 1900 UTC. Meet us this month at the Huntsville Alabama Hamfest. BNB762

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*Continued on page 88*

# HOMING IN

## Radio Direction Finding

Joe Moell P.E. KØOV
PO Box 2508
Fullerton, CA 92633

### Bringing ARDF to your town

"An on-foot foxhunt sounds like a blast! Where's the nearest one?" That's the gist of many responses to my recent columns about world-class radio direction finding (RDF) contests. If the writer is in Scandinavia, northern Europe, or eastern Asia, the answer is easy. This radio sport is popular there and weekly events take place in some cities. But it's still a new concept in North America.

While you can go on a mobile T-hunt every weekend in cities and towns all over the USA, international-style hunting is just beginning to catch on. My best advice is that if you want to go foxhunting, put on a foxhunt or two yourself. Once the sport catches on in your area, you'll have lots of hunts to go on in the future. You may even end up at the World Championships!

Organizing a hunt can be almost as much fun as going on one. April (WA6OPS) and I had the privilege of assisting at international competitions in 1991 and 1993. That made us bold enough to put on two on-foot foxhunts here in southern California. A lot of work went into each one, but everyone agreed they were worthwhile and great fun. From these experiences, I have lots of hints and advice for staging such events.

***Photo A.** Distinctive awards add class to your fox-tailing contest. April Moell WA6OPS designed this trophy for the overall individual winner of VHF-96.*

First, a few words on terminology. "Foxhunting" is a widely-used name for any type of competitive direction finding, particularly international-style on-foot hunts. The term appears to have originated in the late 1940s. Some stateside hams have adopted it to refer to mobile hidden transmitter hunting, too. Unfortunately, non-hams frequently confuse it with the British horse-and-hound sport and get the impression that we are putting defenseless furry animals in jeopardy.

In Japan and China, the terms "fox-teering" and "fox-tailing" are gradually replacing "foxhunting." Swedish hams officially began describing the sport as *Radiopejlorientering* (Radio Direction Finding Orienteering) in 1973. It's accurate, but awkward. Most International Amateur Radio Union (IARU) national member societies have adopted the abbreviation "ARDF" (Amateur Radio Direction Finding), not to be confused with the generic "RDF" abbreviation for any method of finding the source of a radio signal. From now on, "Homing In" will use "fox-tailing" and "ARDF" to refer to international-style on-foot contests and the term "T-hunting" when describing American-style mobile hunts.

### Let's get started

Once you have decided to be your town's ARDF huntmaster, your first mission is to become thoroughly familiar with the basics of fox-tailing. If you haven't already, now would be a good time to read "Homing In" from December 1995, January 1996, and April 1996. I also highly recommend the Radiopejlorientering site on the World Wide Web (http://spitfire.ausys.se:8003/hsn/rpo.htp). There you will find basics of the sport, rules, equipment, results, and schedules of worldwide events.

The pages are edited by Hans Sundgren SM5SVM, with input from Lars Nordgren SMØOY and Per-Axel Nordwaeger SMØBGU. These hams hosted the last ARDF World Championships in 1994. Hans recently expanded his site to include lists of other sites and publications related to all forms of competitive RDF. You will even find the topic index of all "Homing In" columns since the beginning in November 1988.

Mobile T-hunts are often put on by one person with simple gear. Sometimes it's as easy as finding a good spot, turning on the T, and seeing who shows up first. On the other hand, a championship foxhunt always takes careful preparation and a small staff of volunteers to be a success, as you will see. The good news is that only one person needs to have a ham ticket. Consider getting help from anyone who likes outdoor activities. For instance, a local orienteering club was a big help in setting up the 1993 Friendship Radiosport Games foxhunt in Victoria, BC, Canada.

If possible, your hunt should be part of a big amateur radio gathering that will expose our sport to mainstream hams. My first fox-tailing experiences were part of the 1991 and 1993 Friendship Radio Sport Games, which were week-long get-togethers of hams from USA, Japan, Russia, and Canada. In addition to the hunt, these Games included CW competitions, DX contesting, and a trip to a hamfest. The hunts April and I headed up have been part of Hamcon-95 and the West Coast VHF/UHF Conference (VHF-96). If possible, make your hunt a sponsored convention activity. This will get you wider publicity, insurance coverage, and maybe enough cash to cover trophies, certificates, prizes, and refreshments.

An informal spur-of-the-moment RDF "treasure hunt" at a hamfest or picnic can be great fun. But it is better to plan ahead and make a "happening" of your event. Lots of advance publicity is a must. This increases your chance of attracting experienced foxhunters and it encourages everyone to make equipment preparations in advance. Put out the word via hamfest flyers, club newsletters, packet bulletins, and local landline BBSs. Follow up with calls to active T-hunters to make sure they attend and encourage them to spread the word. Remind everyone that all family members who have equipment can hunt—a ham license is not required. Make a special effort to contact hams who do amateur radio activities with schools, Scouts, and youth groups.

To increase attendance and promote fox-tailing, encourage local "ham celebrities" to attend and participate in your hunt. Personally invite club presidents, repeater owners, ARRL officials, and hams in the local media. Offer to provide RDF gear to them, if you have it, to get them to go out on the course. At VHF-96, our ARRL Division Director and Vice-Director competed, along with a representative from ARRL Headquarters Laboratory. They were good sports and their presence and publicity drew a bigger crowd.

### Hunting for dollars?

Regional and world IARU foxhunting championships are true amateur events. Only medals and certificates are awarded to winners. But I think it's OK to encourage larger attendance by giving cash prizes at your hamfest hunt, if funds are available. At Hamcon-95 we awarded cash and trophies for the first five places in each age division, ranging from $50 for first place to $10 for fifth place. The cash prizes at VHF-96 were smaller, but the trophies were nicer (**Photo A**).

Another way to get a greater turnout is to include a team competition. International championships have gold/silver/bronze awards for individuals in four age categories, plus medals for national teams having the best combined individual scores. At VHF-96, we used this method to create friendly rivalries between clubs. Here is what we announced: "When registering, you may declare yourself to be a member of a team representing your club, city, family, etc. Each team may have a minimum of three and a maximum of five members. Each entrant may be on

only one team. (Or he/she may choose to not be on any team.)

"If a club/city/family has more than five hunters, they must split up into more than one team. A team may include members in more than one age division. Team awards are determined by the best three scores of the team members. Just as in the individual competition, scoring is first by number of foxes found and second by time. Team members may not help one another on the course in any way."

All but one of the VHF-96 hunters joined a team. The rivalries were as fierce as any Field Day club competition. One team even had its own cheerleaders (**Photo B**)!

At regional and world championships, there are always two separate contests on separate days. One is on eighty meters with keyed CW, the other is on two meters with MCW signals. Here in Region 2, all ARDF events have been on only 2s meters, where it is easy to use ordinary handie-talkies to get bearings. Almost every active ham has one, so the pool of potential 2-meter hunters is much larger than for 80 meters. Portable RDF sets for 3.5 MHz can be home-brewed readily and I plan to cover that topic in a future "Homing In," but for now we'll stick to 2 meters.

### Finding the right spot

When SMØBGU and his friends chose a site for the last World Championships, they didn't have to look very far. Vast thick forests are plentiful all over Sweden. Its *Allemansratten* (Everyman's Right) principle of law allows citizens free access to any forest or field in the country. Swedish forests are so dense that you sometimes cannot see more than twenty feet in any direction. In an open field, competitors can easily watch one another and will tend to play "follow the leader," but not in a Swedish forest.

City dwellers will find site searching much tougher. Here in southern California, most large parcels of land are barren and arid. Who wants to do ARDF in the desert? For VHF-96, we considered and dismissed the mountains (too far away), the big regional parks (too crowded, admission fees charged) and flood control dam sites (couldn't get permission, liability issues).

We ended up selecting Hillcrest Park in Fullerton. It has lots of elevation changes and enough varieties of flora to be called a botanical park. It's hilly, shady, and close to the convention hotel. The city Parks Department seemed eager to have us and didn't insist on being indemnified as a condition for granting a permit. Hillcrest's only disadvantage is its small size—only 40 acres. While far too small for a world championship, it turned out to be excellent for this group of beginners; not too hard and not too easy.

If your hunt will be in a large forest, good maps are a must. Many European foxhunting champions are also skilled orienteers, insisting on detailed topographical maps with contour lines at 20-foot elevation intervals. Orienteers tell me that only a handful of parks around here have been mapped in this detail, certainly not Hillcrest Park. We ended up making enlarged copies of a 30-year-old map hand-sketched by the Superintendent of Parks. For a 40-acre hunt this was adequate; no one could get lost in a venue of this size. On the other hand, you will want to practice your triangulation skills with better maps if your hunt group is training for the championships.

Do not distribute maps to the hunters until just before the hunt starts. In fact, it is best if the hunt location is kept secret. This prevents competitors from trying to gain an unfair advantage by scouting out the venue, and it minimizes the possibility that hiders will be observed while setting out the foxes. VHF-96 hunters were told to gather at the hotel parking lot at 1 PM Sunday, at which time they were given a sheet with directions to the site.

***Photo B.** Including a team competition will encourage friendly rivalries and increases attendance at your ARDF event. Lara Garrabrant KD6AYO and Rachael Kent KE6GIO decided to be cheerleaders for the Orange County RACES team at VHF-96.*

### Do-it-yourself foxboxes

International rules are very strict about transmitter timing. Following these standards will give hunters experience with the timing cycle they will encounter at future international meets. Championship course foxes transmit for exactly 60 seconds each in numbered sequence. There should be no dead air time between fox transmissions and no overlapping of transmissions.

To meet these requirements, you need a set of identical high-stability timers, one per fox. No ready-to-use commercial foxhunting transmitters or controller/timers meeting these requirements are available in the USA at the time of this writing, so warm up the soldering iron. The Friendship Games hunt used home-brewed TBOX controllers designed by Ron Seese N6MBR. Plans are in "Homing In" for October 1991.

Kevin Kelly N6QAB and J. Scott Bovitz N6MI put the TBOX boards, transceivers, and sealed lead-acid batteries into rugged surplus ammunition cans (**Photo C**). TBOX provides CW audio and PTT timing to any 2 meter transmitter. It has crystal-controlled timing, but getting five of them to start up in proper sequence was tricky. A momentary power glitch will cause loss of synchronization.

***Photo C.** Surplus ammunition cans make excellent waterproof fox enclosures. Kevin Kelly N6QAB is preparing this foxbox for the Friendship Radiosport Games.*

Here is another option to consider, though I have not tried it: Use dual-band handhelds for the foxes. The HT in each fox repeats UHF-to-2-meters with subaudible tone (CTCSS) control. Each fox responds to a different CTCSS frequency. A keyer sends MCW audio for each fox in sequence on the UHF control channel. The keyer also changes the UHF transmitter's CTCSS frequency each minute to select which numbered fox repeats the controller's transmission.

This method will give perfect synchronization, but it requires that the UHF control transmitter's signal be solid copy at each fox. Be sure to disable the 2-meters-to-UHF repeat function on each fox so that they do not retransmit each other's signals onto the control channel. If you use this method, or if you are interested in participating in development of advanced fox controllers for IARU-rules hunting, please contact me.

### Teach 'em and sign 'em up!

If there are technical forums at your convention, be sure to have one on ARDF. Explain the basic rules, give tips for tracking, and show how to get bearings with a handie-talkie and simple accessories. In addition to the ARDF forum, we put on a "clinic" at VHF-96. Prospective hunters were invited to the hotel parking lot late Saturday afternoon, where

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a couple of "easy" foxes had been put out for demonstrations and equipment testing.

Have a prominent sign-up table at the hamfest where people can register for the hunt. Staff it with people who are knowledgeable about ARDF so they can answer questions and encourage everyone to try it. Provide handouts that explain foxhunting and easy on-foot RDF methods. Set a deadline for registration so that you will have sufficient time before the hunt to organize your age divisions, start sequence, etc. Our convention hunts were on Sunday afternoon; the registration deadline was 5 PM Saturday.

OK, you've found a perfect site, built the foxes, spread the word, held a clinic, and registered a bunch of hunters. The hardest part is over. It's time to put out the transmitters, make a starting lineup, run the hunt, tally the scores, and hand out the prizes.

In Part 2 of this series, I'll take you through the process step by step. Meantime, get started on scheduling and site searching for an ARDF event in your own area. Don't forget to send a notice to me. Mail your letters and hunt photos to the address at the beginning of this article. Send E-mail to Homingin@aol.com or 75236.2165@compuserve.com.

The Homing In Web Site isn't quite ready yet, but I have paper copies of my handouts for our recent southern California ARDF events. They are excellent models for your own activities. My handout package includes sample promotional announcements, ARDF information flyers for the sign-up table, teaming information, rules handout for registrants, assembly point instructions, starting lineup/scoring form, and results list. To get the package, send a 6x9-inch self-addressed envelope with 78 cents postage on it (for three ounces) to my post office box. 73

## NEVER SAY DIE

*Continued from page 69*

radio, which was at that time a fast-growing, largely American hobby which was delivering thousands of engineers, technicians, and scientists into the workplace to support and further the American world leadership in electronics and communications. When Coke bought the idea, Bill put them in touch with the ARRL to implement it. This was going to be the biggest publicity coup for the hobby in history! Millions of people would get to see ham stations in operation and be able to send messages home to their family and friends from the Fair. There would be booklets explaining about ham radio and telling people how they, too, could enjoy this wonderful and educational hobby. Lonely? Not when you can turn on a switch and talk with people anywhere in the world!

The plans for having a dozen or so operating ham stations in a large central exhibit area as the main theme for the Coke exhibit unraveled when word leaked out that in return for a $25,000 donation to the League's Building Fund, the exhibit would use only Hallicrafters equipment. The other manufacturers were outraged. As was Coca-Cola, when they found out. So amateur radio ended up with a small out-of-the-way room up on the second floor of the pavilion, next to the toilets, and only reachable via a small stairway. Instead of millions of visitors seeing amateur radio at work and sending messages for them, it was viewed by hundreds.

Could visiting hams get to operate? Har-de-har. I got a lot of angry letters about that from frustrated hams who'd managed to find the place, but then had to stand outside the little room and look in through a window.

Stu Meyer, the president of Hammarlund, was particularly upset over the sell-out of the hobby by the League, so he

*Continued on page 83*

# Ask Kaboom

## Your Tech Answer Man

Michael J. Geier KB1UM
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70 Route 202 North
Peterborough NH 03458

### Fix That Scope!

Last time, we began looking at the internal operation of an oscilloscope, with an eye toward fixing a broken one. Let's continue.

### More power supply

We began at the power supply, assuming the scope was altogether dead. If you've gotten the supply going again, the scope should be working, if simple supply failure was the original problem. If it promptly died again, figure on a short somewhere, and use standard troubleshooting techniques, such as disconnecting circuits one by one to find the short.

If the supply comes up but the scope still doesn't work right, attack the problem in a logical manner—what *part* of the scope isn't working? If there's nothing on the screen at all, the first place to look is the trigger circuitry. The trigger starts the sweep when the incoming signal crosses a voltage threshold you set with the trigger level knob. If the trigger circuits are not working properly, they may inhibit the beam completely, resulting in what looks like a dead scope! Try setting the trigger for "auto" or "free run" operation. Sometimes, that'll get the beam moving. If you still see nothing, it could be a trigger problem, but most likely isn't. Instead, go back toward the power supply and make sure *all* of the output voltages are really there; sometimes, one of them will be missing or way off.

### Dot's nice

If you get a good focused dot on the screen but it won't move, you can assume it is not a high-voltage problem. Is the dot unfocused? Try turning the focus control. If there's no change, something's out in the focus circuit or in the high voltage itself. Most likely, it'll be a diode or a very high-value resistor. Some of those resistors can be in the 10-megohm range or more, making them quite difficult to measure, but if you see a burned one, that's a pretty good indicator of trouble. If there *is* a bad diode, be sure to replace it with a suitable part; a 1N4000-type diode won't work here.

If you can focus the dot, that's a good indicator that the high-voltage section and focus divider network are working fine. Keeping the brightness low (to avoid burning the screen with the non-sweeping dot), try putting a signal into one of the vertical inputs. Just touching the input with your finger ought to do the job. Be sure, of course, that you've set the controls to display that input. If the dot becomes a vertical line, that indicates operation of the vertical section. If nothing happens, even when the vertical attenuator is set for maximum sensitivity, your vertical amplifiers are not working. Or, perhaps, they're not getting all of their required supply voltages.

### Sweep me away

If you do get the vertical line, you're getting somewhere! At this point, the big question is why there's no horizontal sweep. Before you assume it's a sweep problem, be absolutely sure you haven't set the horizontal sweep to "external" or "X/Y." Those settings intentionally disable the horizontal sweep, permitting an external signal to drive the beam back and forth. With no signal, there'll be no sweep, even though there's nothing at all wrong with the scope. I would consider this obvious, and wouldn't even mention it, had I not done it myself a couple of times.

As with other problems, sometimes sweep failures can be traced back to the power supply. In fact, that's often the cause. I have one broken scope right now with precisely this problem. The tip-off is that the vertical amps' position controls have to be turned way off-center in order to put the beam on the screen. That suggests that one of the power supply voltages is not there, or is very low, causing one side of the electrostatic deflection to be quite weak, or causing the vertical amps to be very unbalanced. Only the long-awaited schematic will tell for sure.

If the supply voltages are all there but the sweep still won't run, either the horizontal oscillator or the horizontal amplifier isn't working. Unlike the oscillator, the amplifier is easy to check without another scope. Simply inject some other signal into the external or "Y" input, after setting the sweep for "ext" or "X/Y." If there's no horizontal movement of the beam, the trouble is in the amp. If, though, the beam does deflect, then the oscillator isn't working. Although that sounds like an easy fix, it can get tricky, because the oscillator is gated (stopped and started) by the trigger circuits. Separating the two systems (oscillator and trigger) isn't always easy. At this point, you'll need another scope; a DVM just won't get you very far.

Set the broken scope for free run or "auto" trigger, and see if the gating point, as shown on the schematic, changes from the state it's in when the controls are set for "normal" triggering. It may show pulses, or it just may change polarities, depending on the design. For instance, it may go from zero volts to 10 volts, or something like that. If nothing at all happens, chances are the trouble is in the trigger, not the oscillator, and the problem is causing the oscillator to remain gated off. Most trigger circuits are pretty complex, but they boil down to a comparator of some sort and a timing circuit to sync the oscillator. At the end of the chain is some kind of driver chip or transistor which supplies the gating signal to the horizontal oscillator. That driver is where most of the problems I've ever run into have been located.

If you do see the gating signal, but still have no sweep, suspect the oscillator. The horizontal oscillator itself is usually pretty simple. Basically, it's just a sawtooth wave generator, and may be little more than one or two transistors or IC gates. The tricky part about it, though, is that it is connected to a whole bunch of timing caps and/or coils, in order to provide the various sweep rates. These are connected to the big control you turn to select the rate. As with anything that depends on connections, the connections are often the problem. In particular, check the various switches and rotary controls for good contact. Of course, one of the transistors could be bad; I've seen it once or twice. If you replace one, you may have to recalibrate all the timing elements for the different sweep ranges. Yuck! Of course, if you don't need NIST (National Institute of Standards and Technology, previously the National Bureau of Standards) calibration accuracy, you can just match the ranges to what's shown on your borrowed scope.

### Kitchen sync

If you have the opposite problem (the sweep runs but never syncs), at least you know the oscillator works! In this case, the trouble is almost certainly in the trigger circuits, most likely in that driver again.

Most scopes provide a locking of the trace when in the "auto" mode, but some don't. I spent a bunch of time trying to figure out why a newly acquired NLS Miniscope wouldn't lock in the "auto" mode, even though it locked fine when in the "internal trigger" mode. Then I called the company and found out there was nothing wrong with my scope; it was designed that way! On this particular model, the "auto" mode is really a free-run setting. So, before you waste many hours, be sure the scope is meant to do what you think it should be doing. Of course, if it used to work and now won't, you already know how it ought to be working.

### Hold it

Better scopes have a feature called "delayed sweep," which lets you closely examine various parts of a long waveform, by delaying the start of the sweep by an amount of time you set with the delay knob. Delayed sweep is one of the most useful features on any scope, especially if you work with video signals. Sometimes, the delay circuitry can go out, although it doesn't seem to happen

often. The delay circuit works by intercepting the output of the trigger circuit and delaying it by the amount of time selected. It's basically just a couple of monostable multivibrators ("one-shots"), and isn't too complicated. But, like the horizontal circuit itself, the delay stage is connected to a series of timing elements via various switches and controls. If yours goes out, check those contacts before delving into the circuitry itself.

When using the delayed sweep, you should be able to see various pulses all around the delay circuit. If nothing's moving, something's getting lost somewhere. If the trigger pulse is present on the delay circuit's input, the problem is in the delay itself. If there's nothing coming in, trace back to the trigger circuits and see where the signal disappears.

Well, I think we've covered all of the common problems with oscilloscopes. Now and then, of course, you may run into a weird one that defies logical explanation. Hopefully, though, our exploration has helped you find your scope's failure, and you'll soon be back in business. After all, what would life be like without old faithful?

73 de KB1UM. 73

## NEVER SAY DIE

*Continued from page 81*

formed a manufacturer's group and went to the other Fair exhibitors, looking for a place to show off amateur radio. He found it with the Venezuelan pavilion, which offered some space on the main floor of their pavillion. This one had ham gear from all of the manufacturers.

In order to get a license for the station they needed a ham club to back it. They found one in New York City that was game. I know you're not going to believe this, but the League fought the ham manufacturer's group all the way. They even got Herb Hoover Jr, the ARRL president, to go to Venezuela to try to convince the president of the country to close down the ham exhibit. Then they tried to get the FCC to close it down due to some claimed irregularities in the sponsoring ham club's election process.

The chap who did most of the leg work on the alternative ham station for the Fair was K2AOE, who got so upset over the ARRL moves to shut the exhibit down that he committed suicide. He took things too seriously.

Amateur radio did get exposure at the Venezuelan pavilion, but nothing like it would have had if we'd been the central feature at Coca-Cola exhibit. Little did the folks at Hallicrafters know that they would be put out of business (along with Hammarlund and just about everyone else in the ham industry) within two years as a results of the ARRL's self-promoting "Incentive Licensing" proposal.

I hope you enjoyed my bit of ham history. I'm sure it will anger the brainwashed who truly believe the League can do no wrong. 73

## QRP

*Continued from page 72*

switching arrangement. I did not want to use a rotary switch or relays. I also did not want to move the test leads from one set of jacks to another. I ended up using a 4PDT switch having a center off position. God only knows where this one came from, but a check with several surplus houses should turn up something close. The center off position does exactly what the name implies. It turns the meter off. The meter runs from a 9V battery.

Standard banana jacks are used for the test leads. I always end up losing test leads for the different meters I have, and came real close to hard-wiring them in place.

Radio Shack™ has a slick plastic case with a built-in battery compartment. This made an ideal case to install the meter. I plan to have an engraved plastic panel made to give the project that "commercial" look.

I can now choose between current and voltage with the flip of a switch, without the need to swap test leads. It's accurate enough for me, and rough and tough enough to be kicked around in the toolbox. The meter also makes a great tool to keep on hand for Field Day. 73

### Parts List for Solar Tester

The part numbers are from Hosfelt Electronics™ (1-800 524 6464)

.1 ohm 5 watt 5% power resistors # 47-155

Insulated binding post Red # 80-265

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Test leads # 52-105

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# SPECIAL EVENTS

*Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the September issue, we should receive it by June 30. Provide a clear, concise summary of the essential details about your Special Event.*

### AUG 4

**ANGOLA, IN** The annual Land of Lakes Angola Hamfest, sponsored by the Land of Lakes ARC, will be held 7 AM–2 PM at Steuben County 4-H Fairgrounds, corner of 200 W & 200 N. VE Exams for all classes. Talk-in on 147.180; Packet 145.090; 444.350-131.8 Tone; 444.900/100.0; 224.94; and 53.050. Camping, swimming, chicken BBQ, amusement park, concessions, flea market. Outlet shopping malls nearby. For info and advance tickets, contact *Sharon Brown WD9DSP, 905 W. Parkway Dr., Pleasant Lake IN 46779. Tel. (219) 475-5897.*

**BERRYVILLE, VA** The Shenandoah Valley ARC will host the 46th annual Winchester Hamfest and Computer Show at the Clarke County Ruritan Fairgrounds, 6 AM–3 PM. VE Exams at 8 AM, administered by the Mountain ARC at Cooley School (across from the Hamfest). Pre-reg. requested. Tailgating. Talk-in on 146.22/82 and 146.52 simplex, W4RKC. Contact *Irv Barb KD4VHV, Rt. 3 Box 5385, Berryville VA 22611. Tel. (540) 955-1745.*

**NORTH WASHINGTON, PA** The Skyview Radio Society will have their annual Hamfest 8 AM–3 PM at the Washington Township Fire Hall, just off Route 380 on Route 66. Flea Market setup time is 7 AM. Talk-in on 146.604(-) and 444.900(+). Contact *Robert Reihms N3NOS, 192 North Washington Rd., Apollo PA 15613 USA. Tel. (412) 727-2194 after 9 PM.*

**PORT HURON, MI** The Eastern Michigan ARC Swap '96 will be held at Saint Clair Co. Community College Student Center, 8 AM–2 PM; setup at 6 AM. Walk-in VE Exams; bring a copy of your license, ID, upgrade certificates and VE Fee. Starts at 11 AM, no pre-reg. necessary. Trunk Sales. Forums. Table/Ticket reservation deadline is July 17th. Send orders with an SASE to *EMARC Swap '96, P.O. Box 611230, Port Huron MI 48061-1230.* For more info, call *(810) 367-3059.* Talk-in on 147.300(+) and 146.520.

**RANDOLPH, OH** "Hamfair '96" will be held by the Portage ARC at Portage County Fairgrounds in Randolph, 8 AM–4 PM. Huge Flea Market. Indoor Vendors. Unlimited Free Parking. Forums. WAS-DXCC Card Checking. ARRL Officials. Contact *Joanne Solak KJ3O, at (330) 274-8240.* Talk-in on 145.39/.600 and 28.390. Make ticket and reservation payments to *Portage Amateur Radio Club, 9971 Diagonal Rd., Mantua OH 44255 USA.*

**WELLESLEY, MA** The Wellesley ARS and the Babson Wireless Club will co-sponsor a Ham Flea Market 9 AM–1 PM at Pepsico Pavilion, Babson College, in Wellesley. Tailgating. Talk-in on 147.03/.63 Rptr. Contact *Barbara Holdridge N1ICQ, 107 Church St., Westwood MA 02090; (617) 329-2628;* or *Gerry Driscoll NV1T, 107 Church St., Westwood MA 02090; (617) 444-2686.*

### AUG 9–11

**VERNON, B.C., CANADA** The 5th Annual Sky High Hamfest will be held by the North Okanagan RAC at Silver Star Mountain Resort in Vernon. HF Station. Satellite Station. Seminars. Keynote Speakers. Dealer Displays. Flea Market. Ladies' Programs. Children's Activities. Chair Lift, and more. Get more details from the *North Okanagan RAC, P.O. Box 1706, Vernon B.C., Canada V1T 8C3.* For hotel reservations, call *Silver Star, 1-800-663-4431;* or *Putnam Station 1-800-489-0599.*

### AUG 10

**CROSSVILLE, TN** The Crossville Hamfest will be located at Cumberland County Community Complex, 8 AM–2 PM. VE Exams at 8 AM, pre-reg. only. The test fee will be collected at the Hamfest. For Exam info, write to *AC4AA V.E. Test Session, Rt. 1 Box 20 Legion Loop, Crossville TN 38555.* Exhibitors and tailgaters, for tables contact *Nick Smith WA4GKM, 108 Cardinal Loop, Crossville TN 38555 USA;* or E-mail *nickart@midtenn.net.* Or call him at *(615) 484-5137 (work), or (615) 484-8220 (home).* Talk-in on 146.865. Sponsored by the Plateau ARC.

**DRYDEN, NY** The 16th Annual Finger Lakes Hamfest will be sponsored by the Tompkins County ARC and will take place at the Dryden H.S. Flea Market. VE Exams on site, pre-reg. preferred. New Equipment dealers. RV camping overnight, Fri. Fri. set-up available. Handicapped accessible. Talk-in on 146.97(-). Contact *Ross Boyer N2ISU,* or *Lonnie Boyer N2WGW, at (607) 844-4302 till 10 PM. E-mail: rmb3@cornell.edu.*

**VALPARAISO, IN** The Porter County ARC Hamfest will be held at Porter County Expo Center, 1 mi. south of US 30, on State Rd. 49. Talk-in on 146.775(-)131.8 PL / 146.52. Tailgating. VE Exams 9 AM–11 AM. Setup at 6 AM. Contact *Rich N9QLQ, PCARC Hamfest, P.O. Box 1782, Valparaiso IN 46384-1782. Tel. (219) 762-0484.*

### AUG 11

**CHARLOTTE, NC** The Charlotte ARC Hamfest and Computer Fair will be held 8 AM–4 PM at Roll-A-Round Skate Center, 8830 East Harris Blvd. Tail Gate spaces limited to first come, first served. Flea Market setup at 6 AM. Talk-in on W4CQ 147.06(-). Make checks payable to *Charlotte ARC* and send with an SASE to *Charlotte ARC, P.O. Box 33582, Charlotte NC 28233-3582.* Pre-reg. without SASE or received after Aug. 1st will be held at the door. For info call *Buck Escott WB4OTP, (704) 522-4971, ext. 3330.*

**LEXINGTON, KY** The annual Central Kentucky ARRL Hamfest will be held by the Bluegrass ARS, Inc. at Western Hills H.S., Exit 53 off I-64 in Frankfort KY. VE Exams, Forums, Dealer Exhibits, Flea Market. Indoor commercial vendor space is limited, so reg. early. Deadline is Aug. 1st. Contact *Bill De Vore N4DIT, 112 Brigadoon Pkwy, Lexington KY 40517. Tel. (606) 257-3343 days; (606) 273-8345 eves.*

**ST. CLOUD, MN** The St. Cloud Radio Club will hold its 48th annual Hamfest Aug. 11th. Talk-in on 146.94 and 147.015. For info and tickets, contact *WØSV, 401 Great Northern Dr., Waite Park MN 56387;* or *WØSV @ NFØH.#CMN.MN.USA.NOAM. E-mail: jmaus@cloudnet.com.*

### AUG 17

**BURFORD, ONTARIO, CANADA** Burford Fairgrounds will be the location for the Brantford ARC Flea Market, 9 AM to ?. VE Exams. Talk-in on VE3TCR 147.150(+). For table reservations, contact *Richard La Rose VE3RLX, 153 Dunsdon St., Brantford Ont., Canada N3R 6N3, (519) 752-2437;* or *Brantford ARC, P.O. Box 25036, Brantford Ont. Canada N3T 6K5.*

**RHINELANDER, WI** The Rhinelander Rptr. Assn. and Northwoods ARES will host the Northwoods Hamfest, 8 AM–2 PM, at Sugar Camp Town Hall on Camp Four Rd. in Sugar Camp. Set up Fri. eve. Aug. 16th, 6 PM–10 PM, and Sat. morning at 6 AM. Talk-in on 146.940(-). Contact *Mary Berger NS9Q, 367 Lois St., Rhinelander WI 54501. Tel. (715) 362-9296.*

**WARROAD, MN** Lake of the Woods Rptr. Assn. will hold their Hamfest at Warroad Area Comm. Center, 222 Virginia Ave. NE, Warroad. Wheelchair accessible. Set up at 10 AM; open to the public at 1 PM. VE Exams at 11 AM–walk ins OK. Bring original and photocopy of current license, 2 IDs (one with photo), and a check for $6.05. Dealer and Flea Market tables free with paid admission if reserved in advance. Send check and SASE to *David Landby KBØHAP, RT 3 Box 10, Warroad MN 56763. Tel. (218) 386-1092.* Talk-in on 147.09(+) and 147.00(-).

### AUG 17–18

**HUNTSVILLE, AL** For a good time, stop in at the Von Braun Civic Center in downtown Huntsville and enjoy the 1996 Huntsville Hamfest. Open to the public Sat. at 9 AM, and Sun. at 8:30 AM. Dealer Show. Flea Market. Technical Forums. Banquets, and more. The nearby Huntsville Hilton Hotel will offer special Hamfest rates. Talk-in by K4BFT on 146.94(-) MHz. For more info, call *(205) 534-7175;* or check into *http://www.hamfest.org* on the Web.

**YORK, PA** Visit Memorial Hall at York Fairgrounds 8 AM–4 PM to enjoy the 41st Annual York Hamfest and Computer Show. Commercial Vendors; Software; Hardware; Accessories; Shareware; VE Exams on Sat. by Laurel VECs (no fees),

at Calvary United Methodist Church, 11 North Richland Ave. (1 block from the hamfest); pre-reg. encouraged–call (717) 751-9675. Electronics Flea Market. Banquet Sat. night; ATV Seminar. Handicapped accessible parking. Tailgating. Camping on fairgrounds with 3-point hookups available; contact York Fair Office (717) 848-2596. For hamfest reservations and info, contact *York Hamfest, P.O. Box 351, Dover, PA 17315; Tel. (717) 751-9675.* Talk-in on 146.97(-).

**AUG 18**

**CLARENDON HILLS, IL** The DuPage ARC Hamfest and Computer Show '96 will be held at the Hawthorne Race Course, 3500 South Cicero, Stickney IL. Commercial set up Sat., 3 PM–6 PM; Commercial and Flea Market set up Sun. at 6 AM. Hamfest hours are 8 AM–2 PM. Wheelchair accessible. For tables and Hamfest info, call (708) 985-9256. Advance tickets $4 each (before July 30th). Send check payable to *DARC,* with a No. 10 SASE, to *Hamfest '96, 7511 Walnut Ave., Woodridge IL 60517.* Talk-in on 145.250 MHz.

**LAFAYETTE, IN** The Tippecanoe ARA will conduct VE Exams at the American Red Cross Bldg., 111 N. 7th St., beginning at 1:30 PM. They will also be sponsoring a Hamvention in Lafayette.

**RICHWOOD, OH** The 19th Union County ARC Ham and Computer Fest will be held at the Broadway OH Community Bldg. There is an indoor location for vendors, and ample Tailgate space. Self-contained camping vehicles may park on the grounds. Vendor set up at 6 AM. Open to the general public at 8 AM. Contact *Gene Moore N8YRF, 24461 Claibourne Rd., Marysville OH 43040. Tel. (513) 246-5943.*

**SALINA, KS** The Central Kansas ARC, Inc. will sponsor a Hamfest at the Bicentennial Center Heritage Hall, 9 AM–3 PM. Flea Market. Commercial Vendors. YL and non-ham activities. Talk-in on 147.03(+). Contact Dan Cook AAØTT at (913) 263-8540, or by mail in care of *CKARC, P.O. Box 2493, Salina KS 67401-2493.*

**NORTH TARRYTOWN, NY** The Westchester Emergency Communications Assn., Inc. will hold their "WECA Summerfest 1996" at Yonkers Raceway, Intersection of I-87, Central & Yonkers Ave., Yonkers NY. All outdoor tailgating and more. Talk-in on 147.06/.66. Contact *Tom WB2NHC,* or *Jeanne Raffaelli N2NQY, at (914) 741-6606.*

**AUG 23–25**

**VERNON, CT** The Eastern VHF/UHF Soc. will host their 22nd VHF/UHF Conference at Quality Inn and Conference Center, 51 Hartford Trnpk. Route 83. The VHF-UHF Swap 'n' Sell and Antenna Measuring start at 8 AM. For Swap/Sell info, contact Mark Casey N1LZC, 303 Main St., Hampden MA 01036. Tel. (413) 566-2445. Make check or M.O. payable to *Eastern VHF/UHF Society,* and send to *Rae Bristol K1LXD, 328 Mark Dr., Coventry CT 06238. Tel. (860) 742-8650.*

**AUG 24**

**BRIDGEWATER, NJ** The Somerset County ARS Inc. annual Hamfest will be held at the Somerset County 4-H Center on Milltown Rd., just off Route 202. Time: 8 AM–1 PM. Set up at 6 AM. Talk-in on 448.175(-), or 146.52 simplex. Call Pete *WA2OCN, (908) 429-9093. SCARS, P.O. Box 742, Manville NJ 08835.*

**ST. CHARLES, MO** The St. Charles ARC (WBØHSI) will hold their annual Hamfest at Blanchette Park in St. Charles. For details, contact *William Horn NØYYS, RR 2 Box 240, Troy MO 63379. Tel. (314) 989-2441 9 AM–9 PM.*

**AUG 25**

**CORUNNA, MI** The 19th annual Five County Amateur Radio/Computer Swap and Shop will host the 1996 Michigan State Convention at Shiawassee County Fairgrounds, 2900 E. Hibbard Rd, starting at 8 AM. Set up at 6 AM. This event is co-sponsored by the Bay Area ARC; the Genesee County RC; Lapeer ARA; Mid-Michigan Wireless Assn., and Shiawassee ARA. Advanced sales end August 10th. No advanced trunk sales. For more info, call *Jan at (517) 893-3475.* For space and table orders, include an SASE with your request and send to *Five County Swap 'N Shop, 1214 McKinley Ave., Bay City MI 48708.* Talk-in on 147.020(+) or 146.520 simplex.

**YONKERS, NY** The Yonkers ARC will host a Hamfest/Computerfest 9 AM–3 PM at the Yonkers Municipal Parking Garage on Main St. Set up at 7:30 AM. AC power available with pre-reg. Free Tune-up Clinic. Talk-in on 146.865 Rptr. and 440.150 Rptr. Contact *Jim N2ONM, (914) 969-5182.*

**SEP 7–8**

**BRANDON, MANITOBA, CANADA** The Manitoba AR Museum will host its 2nd Annual Ham Fest on the grounds of the Manitoba Agricultural Museum at Austin Manitoba where MARM is located. Flea Market; Commercial Displays; Computer Fest; Radio Controlled Aircraft demo and display. Camping near the Fest site. Full-course Supper (by advance reg. only); Sat. night Dance/Social. VE Exams; Rabbit Hunts; more. Contact *Dave Snydal VE4XN, 25 Queens Crescent, Brandon Manitoba, Canada R7B 1G1. Tel. (204) 728-2463.* Packet: *VE4XN @ VE4BBS #HWD.MB.CAN.NA.*

**LOUISVILLE, KY** The Greater Louisville Hamfest/ARRL KY State Convention will be held at the Kentucky Fair & Exposition Center. Talk-in 146.28/88. Flea Mkt, Commercial Exhibits, Forums, FCC Exams. Camping available: call (502) 367-5000. For more information, call (812) 294-4905. Send advanced ticket reg. with SASE to *P.O. Box 34444-Q, Louisville KY 40232-4444.* For commercial spaces, call *(812) 948-0037;* Flea Market spaces, *(812) 282-4898.*

**SEP 8**

**DUBUQUE, IA** A Hamfest, Radiofest, Computer Expo will be sponsored by the Great River ARC, Iowa Antique RC and Historical Soc., and Computer Users Groups, 8 AM–2 PM at Dubuque County Fairgrounds. VE Exams by ARRL/VEC. Bring photo ID and one other form of ID, original current license and any CSCE forms applicable, a check or MO made out to ARRL/VEC. For more Exam info, contact *Carl Clark NØKAX, 2145 Delicia Dr., Dubuque IA 52001. Tel. (319) 557-9149.* For Hamfest info, contact *Loren Heber, (319) 556-5755; Jerry Lange, (319) 556-3050; Jerry Ehlers, (319) 583-1016; E-Mail: SHEBER@MWCI.NET;* or *Internet: http://galaxy.mwci.net/grarc/top.htm.* Send payments to *G.R.A.R.C., P.O. Box 546, Dubuque IA 52004.* Talk-in on 147.24/.84 Rptr.

**SPECIAL EVENT STATIONS**

**AUG 3–7**

**OSHAWA, ONTARIO, CANADA** The Ontario Northland "Polar Bear Express" will depart from Cochrane Ont. at about 0800 hours, for its 186 mile journey to Moosonee Ont. in the James Bay lowlands at the southern end of Hudson Bay. An additional passenger car will have several HF stations set up so that DXing can be done en-route. A station will be operated from the train station where part of the group will DX continuously from Aug. 3rd–


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## *Wayne Writes!*

WG5 **Submarine Life In World War II** by Wayne Green W2NSD/1 60p. Wayne's stories of his adventures on the USS Drum SS-228 on five war patrols in the Pacific in 1943-1945. What's it really like on a submarine when you are being depth charged? And what's the day to day life on a submarine like? $7.50

WG6 **Uncle Wayne's Caribbean Adventures** 96 pages. Wayne's adventures scuba diving all around the Caribbean, visiting ham operators, and sight seeing. If you are interested in how to travel economically, you'll get some great ideas from this. He starts out with his "Diving, the Wimp Sport." You'll love the visit to eleven islands in 21 days trip. A measily $7.50

WG7 **Uncle Wayne's Travels**–52 p. Wayne travels to Russia, London, Aspen, and St. Pierre, Munich, Vienna, Krakow, and Prague without it costing nearly as much as you might think. Cheap for you too, at $5.00

WG9 **Wayne Talks: 'Dayton' 1995**. -90 minute tape-What he would have said if he'd been asked to speak. $5.00

WG4 **20/20 Foresight** -Twenty 16 updates on the **Declare War** book - 320p. Further proposals for solving critical American problems, such as a new approach to financing small businesses, how to finance Russia and other countries and make a profit doing it, the real dope on bioelectromagnetics, a new kind of polytechnical university, a new electronic technology, why Africa is in such a mess, why Perot bombed, how to have tuition free universities, a plan for making Congress turn honest, etc. Plenty more. Ridiculously priced at $10.00

Aug. 7th. A second part of the group will head for the water and much sought after IOTA and Canadian Islands. Everyone is invited to come along and have some fun DXing from the train or the station, but you will have to cover all costs for travel, lodging and food. This event is sponsored by the Ontario Northland Railway, Durham Radio, and Alinco. Communications will be in English, Spanish, and Italian. For a rail schedule and round trip fees, call *Ontario Northland at (800) 268-9281.* For updates on the project, visit web page *http://www.durhamradio.ca.* To learn more about joining the expedition, contact Laird Solomon VE3LKS at *(905) 434-7339*; packet *ve3lks@va3bbs*; Internet *lsolomon@osha.igs.net*; *http://www.osha.igs.net/~lsolomon.* To get tourist info on Cochrane, Moosonee, and the surrounding areas, contact *Stephanie Wright at (800) 354-9948.*

**AUG 9–10**

**MIDDLEBOURNE, WV** The Tyler County AR Organization will operate KA8GOH from the 34th annual Tyler County Fair, 1400Z–2200Z Aug. 9th and 10th. Freq: Phone portion of General 80 thru 10 meters. For a certificate, send QSL and a 9"x 12" SASE to *TCARO, P.O. Box 287, Middlebourne WV 26149, USA.*

**AUG 10–11**

**MT. DAVIS, PA** The Somerset County ARC will operate station KB3BOD from the highest point in Pennsylvania. Operations will begin 1700Z Aug. 10th and end 2000Z Aug. 11th. Listen on the lower 50 kHz of the General class phone. The ARC will also broadcast on the CW bands of 10–80 meters as conditions allow. For a certificate send QSL and SASE to *KB3BOD - SCARC, 708 Casselman St., Confluence PA 15424.*

**AUG 11**

**NEW KENSINGTON, PA** Station K3MJW, commemorating the Centennial of the City of Arnold PA, will operate from 1200Z Aug. 10th–0400Z Aug. 11th, on 50.150, the lower portion of General phone; Novice CW on 10, 40, and 80 meters, and Novice phone 28.464. Sponsored by the Skyview Radio Soc. For a certificate, send QSL to *K3MJW, 2335 Turkey Ridge Rd., New Kensington PA 15068, USA.*

**AUG 17–18**

BATAVIA, NY The Genesee Radio Amateurs Club is pleased to announce their 2nd Annual "Wings of Eagles" Special Event Station, to be held at the 16th Annual "Wings of Eagles Airshow," at the Genesee County Airport in Batavia. Operation will be Aug. 17th and 18th between 1300 UTC–2100 UTC on 40 meters at 7.250 ± 20, and on 20 meters at 14.250 ± 20. For a certificate, send a QSL card and a 9" x 12" SASE to *G.R.A.M., Box 572, Batavia NY 14021-0572 USA.*

**ENGLEWOOD, NJ** The 37th New Jersey QSO Party will be on the air Aug. 17th 2000 UTC–Aug. 18th 0700 UTC; and Aug. 18th 1300 UTC–Aug. 19th 0200 UTC. Freq.: 3535, 3950, 7035, 7235, 14035, 14285. Portable and mobile operation is encouraged. For rules, SASE to *EARA, Box 528, Englewood NJ 07631 USA. Sponsored by the Englewood ARA, Inc.*

**VANCOUVER, WA** The Clark County ARC will host an SE Station to help the Northwest Antique Aircraft Club of Vancouver celebrate the annual "fly-in." Operation will be in the lower portion of the General class bands and on 28.450 N/T 10 meter band; plus the 2 meter band, to be announced on the 147.84/.24 W7AIA Rptr. Times: 1500–2300 UTC Sat.; 1500–2200 UTC Sun. For QSL/certificate, SASE to *CCARC, P.O. Box 1424, Vancouver WA 98668 USA.*

**AUG 18**

**SCHAUMBURG, IL** The Schaumburg ARC will operate WB9TXO 1300 UTC–2100 UTC to commemorate SARC's 20th Anniversary. They will be operating 40, 20, 15, and 10 meters up 45 kc from the General portion of the band. For a certificate, send an SASE to *Schaumburg ARC, P.O. Box 68251, Schaumburg IL 60168.*

**AUG 28–SEP 2**

**MT. PLEASANT, IA** The Mt. Pleasant IA ARC will operate WØMME 28 Aug.–2 Sep., during the Midwest Old Threshers Reunion. Operation will be in the General portion of the 80–10 meter phone bands. Visitors attending can reach the station through club rptrs. on 147.39 MHz (+600) and 444.95 MHz (+5), and are encouraged to visit the ham shack and sign the guest register. For a QSL card, send an SASE to *Dave Schneider WDØENR, 1675 Old Highway 34, Mt. Pleasant IA 52641-9580 USA.* For info, contact *NØFIB* on the Internet: *garymcme@interl.net.*

**AUG 31**

**VINTONDALE, PA** KB3BMW will be operated by the Dividing Ridge ARC 12 Noon–6 PM EDT, to commemorate the 150th Anniversary of Eliza Furnace. Freq.: 7.225/.300, and 14.225/.350. For a certificate, write to *DRARC, 199 Bender RD, Apt. #1, Patton PA 16668 USA.* 73


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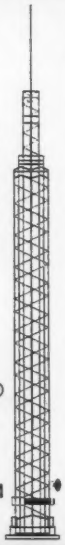

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# PROPAGATION

*Number 87 on your Feedback card*

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

August is *not* expected to be a very good month for HF propagation, as the calendar shows. Poor (P) days are expected to occur during every week except the second. Note the rash of P (Poor) and trending-toward-Poor days each week. For best results, you'll have to try on days marked Fair (F) and Good (G), or trending between them. The remainder might be suitable for gardening, golf, or other outdoor activity. It's even possible that there will be some pretty severe ionospheric disturbances between the 23rd and 25th, so keep a sharp eye and ear tuned to weather lookouts on that weekend, as well.

An intriguing possibility that often accompanies those days marked "P" and "VP" is that when conditions are generally sluggish, these days can be followed by exceptionally *good* propagation, so be sure to check your favorite bands often and monitor WWV at 18 minutes following every hour surrounding those particular days.

Listen for forecasts with improving solar flux (higher numbers) and decreasing "A" and "K" indexes, which are indicators of magnetic field conditions and absorption of signals. Good luck with your DXing.

## AUGUST 1996

| SUN | MON | TUE | WED | THU | FRI | SAT |
|---|---|---|---|---|---|---|
| | | | | 1 P | 2 P-F | 3 F |
| 4 F | 5 F-G | 6 G | 7 G | 8 G-F | 9 F | 10 F-G |
| 11 G | 12 G-F | 13 F-P | 14 P | 15 P | 16 P-F | 17 F |
| 18 F-G | 19 G | 20 G-F | 21 F | 22 F-P | 23 P | 24 VP |
| 25 VP-P | 26 P-F | 27 F-P | 28 P | 29 P-F | 30 F | 31 F-G |

## EASTERN UNITED STATES TO:

| GMT: | 00 | 02 | 04 | 06 | 08 | 10 | 12 | 14 | 16 | 18 | 20 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALASKA | 14 | 14 | 7 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 |
| ARGENTINA | 21 | 14 | 14 | 7 | 7 | 7 | 7 | 14 | 14 | 21 | 21 | 21 |
| AUSTRALIA | 21 | 14 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 14 | 14 |
| CANAL ZONE | 14 | 14 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 21 | 21 |
| ENGLAND | 14 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 | 14 |
| HAWAII | 21 | 14 | 14 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 21 |
| INDIA | 14 | 14 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 |
| JAPAN | 14 | 14 | 14 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 |
| MEXICO | 14 | 14 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 |
| PHILIPPINES | 14 | 14 | 14 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 |
| PUERTO RICO | 14 | 14 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 | 14 |
| SOUTH AFRICA | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 | 14 | 14 |
| U.S.S.R. | 7 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 | 14 |
| WEST COAST | 14 | 14 | 14 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 |

## CENTRAL UNITED STATES TO:

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALASKA | 14 | 14 | 14 | 7 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 |
| ARGENTINA | 21 | 14 | 14 | 7 | 7 | 7 | 7 | 14 | 14 | 21 | 21 | 21 |
| AUSTRALIA | 21 | 14 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 14 | 14 |
| CANAL ZONE | 21 | 14 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 21 | 21 |
| ENGLAND | 14 | 7 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 |
| HAWAII | 21 | 14 | 14 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 21 |
| INDIA | 14 | 14 | 7 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 |
| JAPAN | 14 | 14 | 14 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 |
| MEXICO | 14 | 14 | 7 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 |
| PHILIPPINES | 14 | 14 | 14 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 |
| PUERTO RICO | 14 | 14 | 14 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 | 14 |
| SOUTH AFRICA | 7 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 | 14 |
| U.S.S.R | 7 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 | 14 |

## WESTERN UNITED STATES TO:

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALASKA | 14 | 14 | 7 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 |
| ARGENTINA | 21 | 14 | 14 | 14 | 7 | 7 | 7 | 14 | 21 | 21 | 21 | 21 |
| AUSTRALIA | 21 | 14 | 14 | 14 | 7 | 7 | 7 | 7 | 7 | 7 | 14 | 21 |
| CANAL ZONE | 21 | 14 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 21 | 21 |
| ENGLAND | 14 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 |
| HAWAII | 21 | 14 | 14 | 14 | 7 | 7 | 7 | 7 | 14 | 14 | 21 | 21 |
| INDIA | 14 | 14 | 14 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 |
| JAPAN | 14 | 14 | 14 | 14 | 14 | 7 | 7 | 7 | 14 | 14 | 14 | 14 |
| MEXICO | 14 | 14 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 |
| PHILIPPINES | 14 | 14 | 14 | 14 | 14 | 7 | 7 | 14 | 14 | 14 | 14 | 14 |
| PUERTO RICO | 14 | 14 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 |
| SOUTH AFRICA | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 |
| U.S.S.R. | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 |
| EAST COAST | 14 | 14 | 14 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 | 14 |

### 10–12 meters

This is a daylight-only band this month, but may present openings to tropical areas as well as short-skip openings on the best days (G). During intense sporadic E conditions (rare this month), bursts of strong signals can come and go unexpectedly. Stay alert.

### 15–17 meters

These bands could stay open into early evening hours with possibilities of trans-equatorial DX on Good (G) days and evenings. Signals seem to peak toward the west during afternoon and evening hours. Short-skip to 1,000 miles or so should be available on many days.

### 20 meters

This should be your main choice for DX-chasing. Because some areas of the world are dark and others are in daylight at the same time, you can expect dawn-to-dusk, and even later, DX opportunities on Good (G) days/nights. Short-skip will prevail to about 2,000 miles during the day, and farther at night.

### 30–40 meters

You may find these bands quite noisy (QRN) during the daytime due to the onset of thunderstorms this month, but they will be quieter during the nighttime hours. DX to your east will be the best before midnight, and best to your west before dawn. Choose Good (G) days for the best chances of scoring a new country. Short-skip of 100-1,000 miles during the day, and 500-2,000 miles or so at night, will prevail.

### 80 meters

You may find that 80 meters will provide DX on Good (G) nights, limited by thunderstorm activity. It may also provide short-skip openings of 200 miles or so during the day and 2,000 miles or more after dark.

### 160 meters

There will be *no* daytime openings here, due to a high absorption of signals, but it ought to provide skip to 1,000 miles or so after dark. Only rarely will you find DX, and only on Good (G) nights with low or no thunderstorm activity. Low-frequency static bursts, hundreds of miles in length, limit your summer operations. 73

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What am I looking for? I want to see news of new hams being elmered and licensed. And that the club is backing a member in a run for the state legislature so we'll start having some political clout and not get clobbered every time a tower restriction is proposed. I want to know if your club is giving any technical sesions on different ham modes such as packet, satellites, SSTV, and so on. I want to know about any special club activities such as hamfests, auctions, and so on. I'm always looking for good articles that have appeared first in club newsletters.

**Wayne**


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We are happy to provide Ham Help free on a space-available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double-spaced, on a full 8-1/2" x 11" sheet of paper. Use upper- and lower-case letters where appropriate. Also, print numbers carefully. A 1, for example, can be misread as the letters I, i, or even the number 7. Specifically mention that your message is for the Ham Help Column. Please remember to acknowledge responses to your requests. Thank you for your cooperation.

**WANTED:** Software for the YAESU 747 Computer Controller. Please reply to Robert Hall KC7FRY, 5314 East Linden Place, Tucson AZ 85712.

**Does anyone know** the address of JBI Products and Technologies? Please contact Robert Hall KC7FRY, 5314 East Linden Place, Tucson AZ 85712, and/or Joyce Sawtelle, (603) 924-0058. Thank you.

**WANTED: QSLs.** I took part in the WPX-contest last weekend using the signal J45DZX. Please send the QSLs to Goran Lundell SMØCMH, ELGOVAGEN 11, S-133 36 SALTSJOBADEN, SWEDEN, or via the Swedish QSL-bureau SSA. 73

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# UPDATES

### Simple Parts List Omission

In the May 1996 issue, on page 41, there was an omission in the Parts List of "Simple Multi-Use Amplified Speaker." The list should have also included:

C8 .1µF

C8 does appear correctly in the schematic diagram.

### No, the *other* right

Also in the May issue, a sharp-eyed reader, Jim Farago, pointed out to us that in "Carr's Corner" on page 80, the integrator/voltage doubler is drawn incorrectly. C1 is drawn backwards in polarity and should connect as shown in the unrelated article on page 78 ("Antenna Noise Bridge Detector"): to the junction of D1 cathode and D2 anode.

### U2s have a way of vanishing

In June's "Simple Inductance Meter," on page 57, **U2**, a 78LØ5 5 volt regulator, is missing from the Parts List. We regret any confusion this may have caused. 73

# BARTER 'N' BUY

*Continued from page 78*

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